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Indications, Complications, and Techniques for Emergent Rapid Sequence Intubation Outside the Operating Room

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INDICATIONS, COMPLICAITONS, AND TECHNIQUES FOR EMERGENT RAPID SEQUENCE INTUBATION OUTSIDE THE OPERATING ROOM

By

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ABSTRACT

Airway is the initial and single most important step in any Advanced Cardiac Life Support (ACLS), airway rescue, or trauma resuscitative algorithm. Without a patent airway, further resuscitative measures are futile. Rapid sequence intubation (RSI) is a technique used by Certified Registered Nurse Anesthetists (CRNA) and other appropriately trained healthcare providers to secure the airway in an attempt to regain physiological homeostasis in the failing patient. This procedure, however, is associated with substantial risks. Additionally, those patients requiring RSI are often the most critically ill with a multitude of other injuries or pathology. A thorough understanding of airway management, rapid sequence intubation technique, and potential complications of this technique must be a priority for those professionals involved in airway rescue. The purpose of this review is to explore the most common indications for rapid sequence or emergent tracheal intubations in the critical care setting, to describe the most common techniques and pharmacological agents utilized, and to discuss the complications associated with rapid sequence intubation. The expected outcome of this independent study is that there will be an increase in knowledge and awareness by CRNAs and other healthcare providers that will ultimately result in improved patient outcome.

A comprehensive literature review utilizing retrospective research, prospective studies and case reports regarding the indications, techniques, pharmacological agents

and complications of RSI will be conducted. A power point educational presentation that includes the indications, techniques and complications of RSI will be developed and presented to CRNAs, nurse anesthesia students, and other healthcare professionals involved in airway rescue outside of the operating room. An adult learning theoretical framework will guide this study.

CHAPTER I

INTRODUCTION

Emergency tracheal intubation utilizing a rapid sequence approach (RSI) is the initial and most important medical intervention instituted in any resuscitative attempt. Without a definitive and secure airway, further resuscitative efforts are futile. Certified Registered Nurse Anesthetists (CRNA's) are often called upon for this life saving intervention to areas outside of the operating room, including the critical care setting and emergency room. However, this skill is not preformed strictly by CRNA's, as many other healthcare professionals are involved in emergency intubation, or rapid sequence intubations (RSI), or participate in the care of the patient immediately before and after intubation. All healthcare professionals involved in this life saving, yet potentially dangerous situation, should have a thorough understanding of the procedure, the medications and the potential complications. By obtaining such knowledge of RSI, healthcare professionals will be better equipped to appropriately assist, recognize problems, and improve patient outcome.

Statement of the Problem

Despite being a life saving measure, rapid sequence emergency tracheal intubation is not a benign procedure. A variety of medications, instruments, and techniques are necessary for the rapid sequence intubation procedure and without appropriate knowledge of these components, a misstep in the process could precipitate a negative outcome. Every healthcare provider involved with RSI needs to be familiar with

each component of the process to ensure a safe and effective intubation and a safe outcome for the patient.

Purpose

A successful outcome for every patient requiring rapid sequence intubation is the common goal for all healthcare providers involved in the care of patients. The purpose of this independent study project is to investigate and identify the best practices related to rapid sequence intubation outside of the operating room, including associated complications, and to share that knowledge with other healthcare providers. Sharing this knowledge through educational sessions will improve knowledge and impact patient care. By fully understanding the potential complications, healthcare providers will be able to appropriately anticipate and appropriately treat these complications should they arise.

Theoretical Framework

The art and science of adult learners is known as andragogy. The Andragogical model of adult learning theory is based on several assumptions and will be used to guide this project. Knowles (1984) identifies the following assumptions for the adult learner:

1. The need to know- Before an adult learner will engage in educational activities, they need to know why it is essential to learn the topic at hand. Adults are self directed and are more likely to investigate the need to know and the benefits of knowing the information on their own.
2. The learners self concept- Adults have a psychological need to be seen by others as being self directed and responsible for their decisions. Adults who feel that they are being educated or

treated like children often become resistant. Knowles identifies a conflict in adult learners when faced with this situation as a clash between their intellect and the subconscious need to be self directing. Most people deal with conflict by avoidance or fleeing, which often results in a halt of the adult's learning process.

3. The role of the learner's experience- Adults have a wide variety of life experiences that help shape their self concept and contribute to their educational endeavors. However, these experiences can also set forth biases and serve as barriers to learning. The adult educator therefore is in a unique position because they can assist the adult learner in looking past their presumptions and embracing a new idea or concept.
4. Readiness to learn- The adult learner is willing and interested in learning concepts that directly apply to their daily life and this will allow them to be more effective in their routines. For example, a new graduate registered nurse working in a traditional medical acute care setting would not have a perceived need to learn about RSI because the likelihood of having to assist with one would be rare. However, a registered nurse working in a critical care setting or student nurse anesthesia student will be ready and anxious to learn about this

technique because the likelihood of performing or assisting with an emergency RSI procedure is much more likely.

5. Orientation to learning- Knowles (1984) states that adults are "life-centered" in their orientation to learning, meaning they are task or problem centered. Adults will invest more of their time in learning a new concept or idea if it is related to real life situations or if it will help them with their daily work expectations.
6. Motivation-Internal pressures, such as job satisfaction and quality of life, are the primary factors that motivate adults to learn according to Knowles (1984). External motivators also play a role in adult learning, however to a more limited degree. Examples of external motivators include increased salaries, job promotions, and better career opportunities.

Knowles (1984) established four insightful definitions for the word "adult" when discussing adult learners and adult education. The first definition is the biological definition of adulthood, or the age at which a person can reproduce. The 'legal' definition of an adult is that when a person reaches the age at which they can legally vote or get married. The social definition of an adult describes a person that has taken on responsibilities such as raising a family or maintaining a full time job. The final definition posed by Knowles is that of the psychological adult. The psychological definition describes a person as being an "adult" when they acknowledge that they are responsible for themselves and can be self directed. According to Knowles, it is the

psychological definition that is the most important in terms of education and learning (Knowles, 1984).

Educational goals for adult learners are often based on the adults need for the information. As the instructor, however, it is possible that one would have to help the adult learner become aware of their need to know the information and why it may be relative to them. Adults that feel that they are respected and can relate the learning topic to their life experience are more apt to benefit in their educational goals. If the topic has immediate usefulness to the adult, they are more receptive to the content (Vella, 2002).

The adult learning module as defined by Knowles has been adopted by nursing education programs throughout the nation. The American Nurses Association (ANA) has endorsed this adult learning theory as a guideline for their educational endeavors. The adult learning theory as created by Knowles will be the basis for the independent study project.

Definitions

Key words and concepts that will be utilized throughout this project will be defined as follows:

Acute Respiratory Distress Syndrome (ARDS): used synonymously with acute respiratory failure and was previously known as Adult Respiratory Distress Syndrome. ARDS is a disease process that can result from a variety of clinical conditions or causes, however, patients exhibiting this disease process often have similar pathologic symptoms. Common clinical features seen in patients with ARDS are a triggering noxious event that leads to ARDS, a period lasting from just hours to days of near normal lung function after the lung injury, and the rapid onset of over a few hours and continual progression of

severe hypoxia, dyspnea, diffuse pulmonary infiltrates, and increased noncompliance of the lung tissue.

Advanced Cardiac Life Support (ACLS): an extension of basic life support that has a set list of clinical interventions for the emergency treatment of cardiac or respiratory arrest or other life threatening medical conditions. Persons trained in ACLS are required to have the knowledge and skill to correctly utilize those clinical interventions.

Bronchospasm: a constriction on the muscles in the bronchiole walls that occurs suddenly as a result of airway irritation preceded by laryngoscopy.

Certified Registered Nurse Anesthetist (CRNA): a master's degree prepared registered nurse who has met qualifications to practice anesthesia, including graduation from an accredited anesthesia program and successful completion of the certification examination administered by the Council on Certification of Nurse Anesthetists.

Crash intubation: intubation of the trachea on a patient who does not require induction medications, for example, those in cardiopulmonary arrest.

Emergent/Emergency Tracheal Intubation (ETI): the clinical procedure done in an emergent or emergency situation in which the patient's trachea is "intubated" with an endotracheal tube.

Endotracheal tube (ETT or ET tube): is a flexible plastic tube that is inserted through the oral pharynx into the trachea via the vocal cords to serve as a definitive airway device to ensure a patent airway and as a means to provide mechanical ventilation. Endotracheal tubes have a bulb that is filled with air near the end to help

secure the tube in the trachea below the vocal cords and to help protect the airway from secretions such as blood and vomit.

Intubation: The passage of an endotracheal tube (ET tube or ETT) through the mouth into the trachea via the larynx and vocal cords utilizing a laryngoscope.

Laryngoscope: a medical device used by trained healthcare professionals to aid in the visualization of the glottic opening and vocal cords in order to achieve intubation of the trachea.

Rapid Sequence Intubation (RSI): sometimes referred to as rapid sequence induction and is the administration of medications to facilitate intubation. RSI is performed on patients who are at high risk of aspiration of gastric contents and in need of an advanced airway, such as in the case of critically ill or trauma patients.

Significance of the Project

CRNA's, nurses, physicians, and other health care professionals may play a role in RSI at some point in their daily routine when caring for critically ill patients or if working in an acute care facility. Understanding the process, the indications, and the risks associated with RSI will promote cohesiveness of the team and improve patient outcomes. Having a thorough grasp on technique, equipment, and medications used in RSI will not only benefit the health care provider performing RSI, but will also benefit the patient and all those involved in the process. Knowledge and anticipation of potential problems will help to ensure a smooth and safe intubation.

Assumptions

Healthcare providers (CRNA's, paramedics, nurses, respiratory therapist, etc.) are adult learners with professional backgrounds. It is assumed that these healthcare

professionals will have a basic airway anatomy knowledge base, as well as basic life support and very likely ACLS. CRNAs and other healthcare professionals who engage in the RSI procedure, including administration of medications and performing intubations, are assumed to have knowledge related to intubation and emergency or critical care.

It is also an assumption of this independent study project that the CRNA's and other healthcare providers involved are practicing within their scope of practice. Each individual is also responsible for practicing under the guidelines of their professional organization and place of employment policies. An assumption regarding the research obtained for this project is that the research articles referenced are accurate and truthfully reflected.

Several other assumptions will also be made about the type of adult learners that choose to partake in this educational opportunity:

1. Those utilizing this learning tool want to have a better working knowledge of RSI outside of the operating room
2. Healthcare providers want to be prepared for and informed about RSI so that outcomes may be improved.
3. Safety is a concern for all healthcare professionals. Improving patient outcomes and maximizing patient safety through increased knowledge about RSI is a common goal of all healthcare providers.
4. RSIs in this project will relate solely to adult patients excluding parturients.

Limitations

Pediatric and obstetrical patients have drastically different implications for RSI and therefore will not be covered in this project. Therefore, it is assumed that RSI in this project relates solely to adult patients, excluding parturients.

Multiple complications are associated with a difficult or failed airway and these challenges must be approached by a healthcare professional who is skilled in difficult airway management. Management of the difficult and failed airway includes a unique understanding of those implications, complications, and techniques and will not be addressed in this independent study project. There are also a wide variety of tracheal intubation techniques that bypass the oral tracheal route and respectively have a different set of indications and complications as well. For the sake of this project, tracheal intubation will refer to oral or endotracheal only, excluding nasotracheal, emergency tracheotomy, and emergency cricothyroidotomy.

CHAPTER II

Introduction

When a CRNA or other healthcare provider is confronted with a failing or critically ill patient, the decision to intubate must be made quickly and carried out skillfully. Understanding appropriate indications for RSI may prevent harmful delays in providing a definitive airway or a definitive means of oxygenation for a failing patient. Current trends, including medications and tools needed to perform RSI, will be discussed in this literature review. Understanding current trends and recognizing indications for RSI is equally important when caring for the decompensated patient requiring an emergency airway and will also be discussed. Additionally, the common complications associated with RSI will be included in an effort to help improve the care provided to this type of patient and to positively impact the overall outcome related to this procedure.

Review of Literature

Indications for Emergent Endotracheal Intubation

Walls (2004) states there are three fundamental clinical scenarios that must be assessed when faced with a patient who may require emergency endotracheal intubation. First it must be determined whether or not there is a failure of the patient to protect or maintain his or her own airway. Critically ill patients often have difficulty maintaining an adequate airway and their protective measures may be lost. Next, adequate ventilation and oxygenation is necessary for survival and it needs to be determined if the patient is able to maintain this without assistance. Lastly, anticipation of the continued clinical

course must be established. The question must be asked: will the patient require ongoing mechanical ventilation? This review focuses on emergent endotracheal intubation as an intervention for the critically ill patient in hopes of preventing cardiac arrest. The most common reasons for performing rapid sequence intubations in the critically ill population are respiratory fatigue, failure, and the need for airway protection. Hemodynamic instability is another reason to perform emergent intubations as this is often encountered in diseases such as ARDS (Acute/Adult Respiratory Distress Syndrome), cardiogenic shock, sepsis, trauma, and many other illnesses. The critically ill patient is already compromised due to one or more disease states impairing their physiologic reserve. Emergent intubation coupled with a decrease in physiologic reserve makes this procedure potentially life threatening (Walls & Murphy, 2004).

Mort (2004) describes indications for emergency tracheal intubation (ETI) in a study that looked at the incidence of cardiac arrest during RSIs. After reviewing 3,035 critically ill patients who required ETI, it was concluded that acute cardiovascular disease/pathology was the most common clinical indication for an emergency airway.

Despite these indications for RSI, certain types of patients that more susceptible to adverse outcomes associated with this procedure and, therefore, RSI should be avoided in this group. Patients with intravascular volume depletion, severe acidosis, cardiac decompensation and severe lung injury may suffer serious consequences, including hypotension and vasodilation, when the usual medications and dosages for RSI are administered. These patients would be more likely to respond better to a traditional 'crash' type intubation that does not utilize anesthetic drugs (Walls & Murphy, 2004).

Current Techniques and Medications for RSI

Medications

Medications used for RSI have significantly contributed to the increased success rate of intubation on the first attempt, and have therefore lead to improved patient outcomes. Intubation may be difficult or even impossible without the appropriate use of these medications and may increase the likelihood of patient deterioration. These mediations, however, have recommended induction doses that must be followed or, again, intubation can become extremely chalienging.

Correct dosages are important for multiple reasons. Patients who receive neuromuscular blockers, without appropriate dosages of sedation drugs, remain awake and may suffer from emotional or psychiatric trauma. Laryngoscopy itself has significant hyperdynamic responses associated with it including a surge in catecholamine release leading to hypertension and tachycardia. These hemodynamic responses can be limited, or attenuated, if the patient receives appropriate anesthetic induction medications and doses. Induction medications used in concert with neuromuscular blockers have an additive effect and therefore ease intubation and prevent delays in intubation. Medications themselves, as well as inappropriate doses, can cause significant complications. Additionally, the person performing the intubation, particularly if inexperienced, can impact patient outcome.

Hospital policies and practitioner preferences play a major role in regards to who performs intubations and which medications are used, but all involved should be aware of the appropriate intubation or induction dosages, as well as the potential side effects from these medications.

Midazolam

There is no one ideal sedative agent recommended for RSI, however, midazolam is the most commonly used agent for RSI. Midazolam is a benzodiazepine that produces sedation, amnesia, hypnosis, and muscle relaxation in a dose dependent fashion. Midazolam also has antianxiety and anticonvulsant effects. Unlike other benzodiazepines, midazolam has a chemical structure that prevents the venous irritation that can occur when giving other benzodiazepines intravenously. The chemical structure of midazolam also allows for a rapid onset of action and short duration of action, making it an excellent choice for RSI protocols. The recommended dosage of midazolam for RSI is 0.1-0.3mg/kg (Sagarin et al. 2003).

Despite these recommended dosages for RSI, midazolam has been reported to be frequently underdosed in the RSI setting due to concerns of patients experiencing hypotension. Midazolam has been proven to have minimal cardiovascular side effects and has been noted to have a stable cardiac profile (Nagelhout & Zaglaniczny, 2005). "When the drug was used for induction of anesthesia in healthy humans (0.15mg/kg given intravenously over 15 seconds), systolic blood pressure was decreased 5%, diastolic blood pressure was decreased 10%, and heart rate was increased 18%" (Nagelhout & Zaglaniczny, 2005, p. 119). Sagarin et al. (2003) conducted a comparative prospective study of patients who required ETI. Those who received midazolam at the recommended doses were compared to those patients meeting the same criteria (ETI) who were given other induction agents for RSI. The major finding was that patients requiring RSI and receiving midazolam were, in fact, being under medicated. This under dosing came from healthcare providers who feared hypotension. According to Sagarin (2003), "While some

hypotension accompanies benzodiazepine induction, it is generally not a serious problem. In relatively healthy, normovolemic patients, midazolam at these dosages causes either no change or only modest decreases in mean arterial pressure (MAP≤10 mm Hg)" (p.333).

Several studies conducted on patients with limited cardiac reserve were also noted by Sagarin et al, (2003) and determined that when midazolam was given to these patients in doses of 0.2-0.3mg/kg, decreases of MAP of only 10-20mm Hg were identified. Additionally, the MAP returned to baseline rapidly after the intubation.

Hypertension and tachycardia can and often do result from laryngoscopy and these cardiovascular responses can be attenuated with the use of medications such as midazolam, as well as lidocaine and opioid narcotics, most notably fentanyl.

Lidocaine

Lidocaine is often administered prior to laryngoscopy to attenuate hemodynamic responses. The recommended dosage for RSI is 1.5mg/kg (Morgan, Mikhail, & Murray, 2006). Lidocaine is an amide local anesthetic agent often used in RSI protocols because it not only attenuates hyperdynamic reactions to intubation, but lidocaine also decreases cerebral blood flow and blunts the rise in intracranial pressure that often is associated with intubation. Lidocaine has also been shown to be effective in blocking bronchoconstriction that may occur as a reflex to intubation (Morgan et al., 2006).

Toxicity can result from administration of local anesthetics, including lidocaine. This is rarely encountered during RSI; nevertheless, the correct dosage needs to be recognized by those administering the medication to prevent this potential and life threatening complication. The safe maximum dose of lidocaine is 4mg/kg (Morgan et al.,

2006). Early symptoms of lidocaine toxicity include circumoral numbness, tongue paraesthesia and dizziness. Blurred vision, tinnitus, restlessness, agitation and nervousness are also symptoms and precede central nervous system depression. Tonic clonic seizures can result from local anesthesia toxicity and are signaled by the onset of muscle twitching. The occurrence of seizures can be diminished by premedication with benzodiazepines, such as midazolam. Local anesthetic toxicity may be difficult to identify in the patient who is requiring RSI, so preventing the occurrence of toxicity is important (Morgan et al., 2006).

Despite having earned a place in many RSI protocols, there is some noted opposition to the use of lidocaine in these emergency intubation situations. A literature review by Robinson and Clancy (2001) conducted to identify the benefits of intravenous lidocaine used for RSI on patients with traumatic head injury, could find no evidence that IV lidocaine reduced intracranial pressure (Robinson & Clancy, 2001). Intravenous lidocaine may reduce MAP and this decrease can last for several minutes, proving potentially hazardous in the failing patient requiring RSI. A study conducted by Asfar and Abdulla (1990) determined that when intravenous lidocaine (1mg/kg) was used in combination with succinylcholine and thiopental induction techniques for elective surgery, 95% of the patients had a reduction of their MAP by an average of 30mm Hg when compared to those who had received a placebo. They concluded that not only will intravenous lidocaine blunt the increased intracranial pressure associated with RSI, it will in turn decrease cerebral perfusion pressure as the MAP is decreased, thereby having no benefit for intracerebral protection (Asfar & Abdulla, 1990).

If chosen, premedication with intravenous lidocaine should occur several minutes prior to the intubation in order to effectively blunt the hemodynamic response to laryngoscopy. Opposition to the use of lidocaine for preventing an increase in intracranial pressure related to RSI and laryngoscopy has been related to the timing of administration. Vaillancourt & Kapur state that if the intent of lidocaine administration is to prevent a rise in intracranial pressure, then the lidocaine must be administered early enough, whereas if it is given immediately prior to the laryngoscopic attempt, it will have no benefit and will in turn result in a decrease MAP and cerebral perfusion pressure (Vaillancourt & Kapur, 2007).

Opioids

Fentanyl is a synthetic opioid that produces profound dose dependent respiratory depression, sedation, and analgesia and has gained an important place in the RSI protocol. Fentanyl has a rapid onset due to its high lipid solubility which allows for a rapid uptake by the tissues and has a short duration of action. Laryngoscopy stimulates a surge in catecholamine release which can lead to tachycardia and hypertension. Fentanyl can attenuate this hyperdynamic response to intubation. Intubating doses of fentanyl are typically 2-3 μ/kg. Several advantages to the use of fentanyl in any RSI protocol are: a lack of direct myocardial depression, suppression of the stress response to laryngoscopy, and the lack of histamine release.

Despite having the reputation as being cardiac stable, fentanyl has been associated with some side effects that the healthcare provider must be aware of when caring for patients. Fentanyl does not produce amnesia so should not be used without a benzodiazepine for RSI. Fentanyl can also cause dose dependent respiratory depression.

As previously mentioned, fentanyl does not cause histamine release and therefore there is no dilation of the venous capacitance vessels which would lead to hypotension, however, fentanyl does markedly depress the carotid sinus baroreflex control of the heart rate. Hypotension related to fentanyl, typically with higher doses (50mcg/kg), is generally a result of bradycardia due to depression of the carotid sinus and can progress to a decrease of cardiac output. Rapid intravenous administration of opioids, including fentanyl, can lead to skeletal muscle rigidity and myoclonus, often misinterpreted as seizure activity. Fentanyl has been associated with modest increases in ICP despite maintaining an adequate $PaCO_2$, so must be used with caution in patients with increased intracranial pressure (ICP) requiring RSI. This increase in ICP has been attributed to the decrease in mean arterial pressure and cerebral perfusion pressure that can follow fentanyl administration (Stoelting, 2006).

Hypnotic Induction Agents

Propofol is an intravenous hypnotic agent that has a rapid onset and short duration of action, therefore making it a favorable choice by CRNA's and other anesthesia personnel involved in RSIs. This medication is potent and can rapidly depress the patient's respirations and therefore must only be administered by personnel skilled in airway management. The chemical makeup of propofol gives this drug its ideal characteristics. Propofol is 2,6-diisopropylphenol and is administered as a 1% solution in a mixture of 10% soybean oil, 2.25% glycerol, and 1.2% purified egg phosphatide. The metabolic clearance of propofol is rapid and exceeds hepatic blood flow, attributing to the uniqueness of this medication. Rapid intravenous (IV) injection of propofol can produce unconsciousness in about thirty seconds and arousal is more rapid and complete.

Compared to other medications used for induction of anesthesia or used in RSI protocols, the main advantage of using propofol is the more rapid and complete wakeup with little residual central nervous system (CNS) effect. Propofol has also been shown to possess anti-inflammatory and bronchodilating properties, which add to the drugs appeal for RSI protocols. Propofol also has anticonvulsant properties, decreases intracranial pressures, and decreases cerebral oxygen consumption and is therefore useful in RSI protocols for patients with asthma, head injuries, and other critical illnesses. A typical induction dose of propofol is 2mg/kg, however reduced doses are often required for the elderly and patients suffering from cardiac decompensation, while pediatrics will require a higher than normal dose due to a higher volume of distribution in the pediatric population (Nagelhout, 2005).

Propofol is a very important medication in terms of RSI protocols; however, it also carries significant warnings. Due to its chemical makeup, propofol formulations have a high incidence of supporting bacterial growth, despite advances in preservatives. Open vials of propofol or any drug that has been previously drawn up in a syringe must be discarded within six hours due to the risk of bacterial growth. Hypersensitivity reactions can also occur with the propofol preparations that contain sodium metabisulfite, a preservative added to propofol to prevent bacterial contamination. Bronchospasm and asthma exacerbation have been known to occur with the administration of propofol to patients with reactive airway disease that also have sulfite sensitivity. According to Marik (2004), "Sulfite sensitivity has been reported in up to 10% of asthmatics" (p.3642). Patients with allergies to eggs, lecithin, and soybeans are at an increased risk for an allergic reaction with the administration of propofol. Lecithin is derived from egg yolks

and is a component of the propofol formulation; however, most patients with egg allergies have an IgE mediated hypersensitivity to the proteins found in the egg whites, and lecithin is found in egg yolks. Lecithin is not acknowledged as a problem for patients with allergies to eggs. Most of the allergic reactions have been proven to be related to the isopropyl or phenol groups, which also contributes to the pain experienced on injection (Laxenaire, 1992).

Conscious patients that are in need of RSI can and often do experience pain upon injection of propofol. Pain is more likely to occur if the propofol is administered into the small veins of the hands and this pain may be minimized or avoided by administering propofol into larger veins.

> According to Stoelting (2006) "Pain on injection is the most commonly reported adverse event associated with propofol administration to awake patients. This unpleasant side effect of propofol occurs in <10% of patients when the drug is injected into a large vein rather than a dorsum vein on the hand. Preceding the propofol with (using the same injection site as for propofol) 1% lidocaine or by prior administration of a potent short acting opioid decreases the incidence of discomfort experienced by the patient" (p.163).

Many practitioners encourage the use of intravenous lidocaine prior to the administration of propofol not only for the protective effects of lidocaine in regards to blunting the sympathetic response to laryngoscopy, but also to blunt the pain response from the infusion of propofol. A randomized prospective study conducted on 270 patients scheduled for elective surgery under general anesthesia investigated whether or not lidocaine given prior to propofol would actually decrease the incidence of pain on

injection of propofol. The conclusion found that there was no difference in the intensity or severity of pain between the group that had received a dose of 20mg of lidocaine prior to propofol and the group that received no pretreatment prior to the propofol (Krobbuaban, 2008).

Myoclonus can also occur with the administration of propofol, however, propofol associated myoclonus occurs less frequently than with administration of other induction medications such as etomidate, methohexital, and thiopental (Nagelhout, 2005).

Significant cardiac depression can occur with the typical intubating doses of propofol and becomes more pronounced with higher doses. Anesthesia personnel involved in the RSI process and administering propofol must be mindful of this, especially with the elderly age group. The cardiac depressant effects can be reduced in the elderly and patients with cardiac impairment by administering a decreased dose (Morgan et al., 2006).

Propofol not only induces unconsciousness in about thirty seconds, but also causes dose dependent respiratory depression with apnea occurring in approximately 25-35% of patients after receiving induction doses of propofol. Many RSI protocols call for the administration of opioids, such fentanyl, and when administered in conjunction with propofol they can enhance the ventilatory depressant effect of propofol (Stoelting, 2006). Respiratory depression is not an unwanted effect when performing a RSI, however, a person skilled in airway management must be available when this medication is administered in the setting of an emergent intubation.

Chemically unrelated to any other drug used for IV induction, etomidate is a hypnotic agent that has earned a place in many RSI protocols for its ability to be used

with cardiovascularly unstable patients. According to Stoelting (2006), "Etomidate may be viewed as an alternative to propofol or barbiturates for the IV induction of anesthesia, especially in the presence of an unstable cardiovascular system" (p.164). Etomidate has a rapid onset of action, and with a typical induction dose of 0.2-0.4mg/kg, unconsciousness can occur in one arm to brain circulation time. Arousal after a single dose of etomidate is rapid and has little residual CNS effects when compared to barbiturates. Etomidate does not induce a histamine release and has minimal associated respiratory depression, provides myocardial and cerebral protection from ischemia, and therefore, has been deemed an ideal medication for RSI situations in which little hemodynamic change is desired (Morgan et al., 2006).

Few side effects are associated with etomidate; however, those administering this medication need to be aware of those that do exist. Pain on injection is associated with the administration of etomidate and it is often suggested that pretreatment with lidocaine or administration in a larger vein be employed to decrease the likelihood of infusion pain. Etomidate manufacturers have utilized a lipid emulsion rather than a propylene glycol solution which in turn has nearly eliminated the incidence of pain associated with etomidate administration (Stoelting, 2006). As with propofol and other hypnotic agents, analgesia is not associated with etomidate administration, therefore, premedication with an opioid prior to intubation is necessary to blunt the hemodynamic response associated with laryngoscopy.

Myoclonus, dystonia, and tremors can be seen after etomidate administration due to the excitatory effects caused by this IV anesthetic agent. Etomidate commonly produces myoclonic movements in patients; however, this can be attenuated by

premedication with an opioid such as fentanyl. A study of 67 unmedicated patients found that excitatory effects, including myoclonus, tremor, and dystonic posturing, occurred in 86.6% of the patients who had received etomidate, and it was advised that the use of etomidate be undertaken with caution in patients having seizure histories (Reddy, 1993). Stoelting (2006) states that these spontaneous movements in the absence of premedication, particularly myoclonic movements, occur in 50%-80% of patients receiving etomidate.

The most serious side effect attributed to the use of etomidate is the transient adrenocortical suppression, and is also the most limiting factor for the use of this medication. Etomidate produces adrenocortical depression by inhibiting the enzyme 11-beta-hydroxylase, and to a lesser extent, 17-α-hydroxylase. Adrenal suppression from a decrease in cortisol and aldosterone levels has been noted to occur approximately 30 minutes after a single induction dose and by inhibiting these enzymes, the conversion of cholesterol to cortisol is inhibited for up to 24 hours after a single induction dose of etomidate. The etomidate associated adrenal suppression was first noted to be significant after its earlier uses as a continuous drip, which is no longer instituted. However, the controversy over the use of etomidate for patients at an increased risk for adrenal suppression remains. Several studies have shown that there is a transient adrenocortical suppression, meaning less than 24 hours, however, it is uncertain whether or not this transient suppression is clinically significant due to insufficient long term studies (Zed, 2006). Patients who are particularly at an increased risk for adrenal suppression related to the administration of etomidate are those patients who have systemic bacterial infections or are septic. Etomidate induced adrenocortical suppression in these patients would likely

create a more unfavorable clinical picture despite its hemodynamic stability. Zed (2006) proposes three options for the use of etomidate in the clinical setting for patients with septic shock:

1) Avoid use of etomidate for this patient population
2) Decrease the induction dose of etomidate, as well as lowering the dosages of adjunct induction medications
3) Administer corticosteroids with etomidate

Despite lowering the dose of etomidate for this patient group, it has been noted that adrenal suppression may occur in doses as small as 0.04mg/kg. A study in 2002 by Annane et al. investigated the use of corticosteroids in the reduction of mortality in patients with septic shock. In this study, a portion of the patients had been intubated and had received etomidate as part of the intubation medication regimen. The mortality rate in the group of patients who received etomidate and were subsequently treated with corticosteroids was 54.8%, whereas the group of patients who had received etomidate and were not given corticosteroids had a mortality rate of 75.7% (Zed, 2006). Zed (2006) further recommends that patients who have received etomidate and are known to be in septic shock receive a baseline serum cortisol level and be treated with hydrocortisone 50mg every 6 hours until a 250 mcg cosyntropin stimulation test (CST) can be resulted.

Neuromuscular blockers

RSI has become the standard emergency airway management technique outside of the operating room. For success, however, optimal intubating conditions must be obtained for a successful intubation with minimal risk of aspiration. Often during emergent intubations, patients can become combative, restless, or their jaws can become

rigid, making intubation difficult and sometimes impossible (Reynolds et al. 2005). Neuromuscular blockade (NMB) agents are used in RSI situations to improve the initial attempt success rate by providing motor paralysis. The two most common NMBs used for RSI include succinylcholine and rocuronium. NMBs work pharmacologically by disrupting the transmission of nerve impulses as they arrive at the neuromuscular junction (NMJ) (Stoelting, 2006).

Succinylcholine is a depolarizing NMB, meaning it mimics the acts of acetylcholine at the NMJ. By mimicking the action of acetylcholine, the skeletal muscles are rapidly depolarized over and over until they can no longer produce a muscular action potential, resulting in fasciculations. Succinylcholine is eliminated in the body by plasmacholinesterases; therefore their concentration levels in the synaptic cleft do not fall as rapidly as acetylcholine resulting in a prolonged depolarization of the motor end plate. Continuous muscle depolarization causes muscle relaxation, which is called a phase I block. Once the plasma cholinesterase metabolizes succinylcholine, the neuromuscular junction returns to its physiological state. Succinylcholine produces rapid and intense paralysis, yet its effects will likely be gone before a healthy preoxygenated patient will start to become hypoxic. The short duration of action (approximately 10 minutes) of succinylcholine has been noted as being an advantage if unexpected difficulties with laryngoscopies and intubations arise. Intubating does of succinylcholine are 1-1.5mg/kg when administered intravenously, and the time to onset of action is 30-60 seconds (Nagelhout, 2005).

A disadvantage to the use of succinylcholine is related to its actions on the cardiac cholinergic receptors. Heart rate and blood pressure can be decreased as a

direct result of stimulation of the nicotinic receptors in the parasympathetic ganglia, as well as stimulation of the muscarinic receptors in the sinoatrial node of the heart (Morgan et al., 2006). Children are at particular risk for this serious complication. Bradycardia more often develops only in those adults who have received a second injection of succinylcholine within 3 to 8 minutes of the first dose.

Fasciculations, or continual motor unit contractions, signify the onset of paralysis by succinylcholine. Patients who have received succinylcholine have an increased risk for post intubation myalgia in relation to the fasciculations. Fasciculations in the abdominal wall can lead to increased intragastric pressure, which is then offset by an increase in lower esophageal sphincter tone, which probably does not increase the risk for gastric reflux or aspiration (Morgan et al., 2006). Damage to the skeletal muscles as evidenced by the occurrence of myoglobinuria after succinylcholine administration can also be attributed to the fasciculations; however this is a rare occurrence in adults and occurs more often in the pediatric population (Stoelting & Hillier, 2006).

Paralytic effects can be prolonged in patients with atypical plasma cholinesterase deficiencies, or by administering a large dose of succinylcholine which can result in a phase II block. Patients with plasma cholinesterase deficiencies cannot break down the succinylcholine, thereby prolonging the neuromuscular blockade. Administration of a large dose (2-4mg/kg) or repeated doses of succinylcholine can result in the aforementioned phase II block. The neuromuscular receptor blockade takes on the characteristics of a nondepolarizing NMB; however, succinylcholine cannot be reversed as can the nondepolarizing agents (Morgan et al., 2006). Phase II blockade is rarely an issue in the setting outside of the operating room unless succinylcholine has to be

readministered, in which case, the healthcare provider involved should be aware of this clinically significant effect.

Succinylcholine can stimulate the skeletal muscle to release potassium, typically raising the serum potassium level by 0.5mEq/L. This rise in serum potassium in the normal healthy adult with normal baseline potassium is considered benign and transient. Patients who have preexisting hyperkalemia, are in renal failure, trauma or burn patients, or those with neurological disorders are at greatest risk for detrimental effects related to this rise in serum potassium. Several other conditions predisposing patients to undesirable effects from succinylcholine hyperkalemia are summarized in the following table adopted from Morgan et al. (2006). Cardiac arrest resulting from the increased potassium levels can be refractory to resuscitative efforts and care should be taken to avoid such circumstances.

Table 1

Burn injury	Massive trauma
Prolonged total body immobilization	Severe intraabdominal infection
Ruptured cerebral aneurysm	Stroke
Spinal cord injury	Guillain-Barré syndrome
Encephalitis	Severe Parkinson's disease
Myopathies (e.g., Duchenne's dystrophy)	Tetanus
Polyneuropathy	Hemorrhagic shock with metabolic acidosis
Closed head injury	

Conditions Causing Susceptibility to Succinylcholine-Induced Hyperkalemia.
Morgan, G., Mikhail, M., & Murray, M. (2006). *Clinical Anesthesiology* (4th ed.). New York: Lange Medical Books/McGraw-Hill.

Patients with open globe eye injuries should not receive succinylcholine as this medication causes increased intraocular pressures 2-4 minutes after its administration. The increased intraocular pressure can last from 5-10 minutes and is therefore considered

to be a transient increase. The mechanism by which succinylcholine increases the intraocular pressure is not exactly known, but one theory is that the extraocular muscles are contracted with distortion and compression of the globe of the eye. The primary fear of increased ocular pressures is the thought that such contraction may expel global contents in a patient who has an open eye injury (Stoelting & Hillier, 2006).

Increased intracranial pressure is also a side effect of succinylcholine and is generally a result of slight increases in cerebral blood flow and stimulation of the muscle stretch receptors, which increase cerebral activity. This increase in intracranial pressure can be attenuated by pretreatment with a nondepolarizing muscle relaxant and administering lidocaine (1.2-2mg/kg) 2-3 minutes prior to intubation. Succinylcholine can also trigger a histamine release from mast cells which can trigger skin flushing, bronchospasm, and hypotension from the peripheral dilation (Morgan et al., 2006).

Masseter muscle rigidity can be triggered by the administration of succinylcholine. The muscle tone of the masseter muscles is greatly increased and can make laryngoscopy difficult due to the incomplete relaxation of the jaw. However, inability to intubate due to masseter muscle rigidity is not typical and in such cases the clinician might suspect a more sinister condition such as malignant hyperthermia. Malignant hyperthermia (MH) is an inherited hypermetabolic disorder of the skeletal muscle, and a potent triggering agent of this disorder is succinylcholine (Morgan et al., 2006). In MH susceptible patients, once they receive succinylcholine, there is an increased concentration of calcium in the muscle cells. The result is sustained muscle contractions and rigidity. According to Nagelhout (2005), sarcolemma destruction occurs from acidosis, hyperthermia and depletion of adenosine-5'-triphosphate (ATP) as a result

of malignant hyperthermia. With the destruction of the sarcolemma, a large efflux of potassium, myoglobin and creatinine kinase occurs to the extracellular fluid. Malignant hyperthermia if left untreated is rapidly progressive and often fatal, so prompt recognition is a must

Rocuronium is an aminosteroid nondepolarizing NMB, meaning that it is a medication that interferes, or competes with acetylcholine at the NMJ. Nondepolarizing NMBs (NDNMB), such as rocuronium, bind to the acetylcholine receptors, thereby preventing acetylcholine from binding to its receptor so no endplate potential develops and neuromuscular blockade ensues. A typical intubating dose of rocuronium is 0.6 to 1.0 mg/kg. Rocuronium has a rapid onset of action of 1-2 minutes and duration of action lasting from 20-35 minutes. It is the rapid onset of action that has earned this drug a place in many RSI algorithms. Rocuronium does not elicit a histamine response, nor does it stimulate the cardiac muscarinic or nicotinic receptors as with succinylcholine. Rocuronium is largely excreted unchanged in the bile, as much as up to 50% in the first 2 hours, however, it still relies on kidney and liver function for the rest of the elimination process. A prolonged response to rocuronium can occur if given to patients with renal failure or liver disease (Stoelting & Hillier, 2006).

Other than an allergy to rocuronium or other medications in the aminosteroid class, there are no absolute contraindications to the use of this medication. Care should be taken, however, with the patient that presents with a difficult airway as the duration of action of rocuronium is significantly longer than that of succinylcholine. Nondepolarizing agents can be reversed by a class of drugs known as anticholinesterases,

but the routine reversal of NDNMB is rarely performed in the RSI outside of the operating room.

Currently, the paralytic drug of choice for RSI is succinylcholine as it is more likely to provide excellent intubating conditions in a shorter period of time when compared to rocuronium (Walls & Murphy, 2004). However, a dose of 0.6mg/kg of rocuronium will produce acceptable intubating conditions and result in a shorter apneic period than rocuronium at a dose 1mg/kg, and is considered an acceptable alternative to succinylcholine when succinylcholine is contraindicated or not available (Neilipovitz, 2007). Healthcare providers must remember that succinylcholine and rocuronium are paralytic agents only and do not render unconsciousness, analgesia, or amnesia.

The medications chosen for RSIs will vary from facility to facility and it is the responsibility of each healthcare provider who is involved in these emergency intubations to be aware of and informed of the common medications used for RSIs, their associated side effects, and the expected results of each pharmacological agent.

Current Techniques

Rapid sequence intubation (RSI) is one technique for securing the airway in patients requiring airway rescue. RSI involves a series of steps that ultimately results in the correct placement of an endotracheal tube (ETT). The current technique employed for RSI includes preoxygenation of the patient, rapid administration of induction and paralytic medications according to the predetermined dosages, concurrent application of cricoid pressure, limiting or avoiding bag-valve-mask ventilation, and direct laryngoscopy followed by the intubation of the trachea and confirmation of tube placement.

Preoxygenation for a patient requiring RSI should be started with 100% oxygen approximately 3 minutes prior to induction with medication, preferably 5 minutes before the administration of NMB. Preoxygenation is an essential component to the RSI protocol, especially since bag-valve-masking is contraindicated after induction. The establishment of an oxygen reservoir in the lungs and body tissues prior to intubation is the goal of preoxygenation, and its intent is to allow for several minutes of apnea to pass without arterial oxygen desaturation. Besides creating an oxygen reservoir, preoxygenation supplies the body and body tissues with an oxygen surplus to allow for prolonged periods of apnea without desaturation. In an alert and cooperative patient, typically not the case when emergent RSI is needed, the patient can obtain the same preoxygenation status by taking 8 vital capacity breaths while receiving 100% oxygen. Vital capacity breaths are described as the largest volume of breaths the patient can take (Walls & Murphy, 2004).

Despite the current practice guidelines regarding ETI or RSI involving preoxygenation via bag valve mask or other noninvasive means, it has been argued that preoxygenation may not be beneficial to the critically ill patient who is already experiencing hypoxia or respiratory failure. In fact, Mort (2005) conducted a study on 42 critically ill patients who required emergent intubations and found that the critically ill population had minimal improvements in their blood oxygen tensions, which was used as an indication of effective oxygenation, as compared to the control group of stable elective open cardiac surgery patients (Mort, 2005). This stand alone study has not altered the practice guidelines for emergent RSI procedures, but further investigation is warranted on this topic. This study was noted to be the first of its kind and has several limitations, the

Cricoid pressure has been a standard of care and has had a pivotal role in RSI protocols since its discovery in 1966 by Sellick (Ellis, 2007). Sellick's technique was to apply backwards pressure on the cricoid cartilage, thereby compressing the esophagus against the vertebral body. Sellick proposed that this maneuver, frequently termed Sellick's maneuver, would occlude the esophagus and prevent gastric contents from being regurgitated into the pharynx and being aspirated into the pulmonary structures. Not only does cricoid pressure prevent aspiration of gastric contents, but also prevents or limits the amount of gastric insufflation during ventilation by bag-valve-mask techniques. A dilated stomach can precipitate gastric regurgitation, as well as lead to diaphragmatic splinting, hypoventilation, or barotrauma. Cricoid pressure is not a benign intervention however. There are associated risks involved with this maneuver including a change in gastroesophageal physiology, primarily the lower esophageal sphincter. Cricoid pressure in theory acts similarly to the upper esophageal sphincter. The effectiveness of the lower esophageal sphincter tone relies on the difference in pressures from the lower esophageal sphincter pressure and the intragastric pressure, which is known as barrier pressure. Ellis et al. (2007) states that studies conducted on anesthetized patients who had received cricoid pressure prior to intubation confirmed that cricoid pressure causes a significant decrease (29%) in lower esophageal sphincter pressure which in turn decreases the barrier pressure by as much as 44%. Reductions of such magnitude in lower esophageal pressure are associated with increased gastric distention with bag-valve-mask ventilation techniques (Ellis, 2007).

Additionally, esophageal rupture has been reported in patients who have vomited while having cricoid pressure applied (Ellis, 2007). Rupture of the cricoid cartilage is

another life threatening risk associated with cricoid pressure application. Recent studies advise against the use of cricoid pressure while the patient is conscious due to the uncomfortable nature of the maneuver, as well as the increased risk of inducing vomiting, aspiration and esophageal or cricoid injury (Ellis, 2007).

The degree and force of cricoid pressure is an important factor when using the Sellick's maneuver because excessive force can contribute to difficulty with laryngoscopy, ventilation, as well as other complications, such as cricoid cartilage damage (Ellis, 2007). Multiple studies have shown that the application of cricoid pressure by a majority of trained healthcare providers is inadequate. This same study showed that the ability to apply proper cricoid pressure did improve with training. A follow up assessment at three months, however, proved that the healthcare providers did not retain their improved skills (Ellis, 2007). A recent study conducted by Quigley and Jeffrey (2007) evaluated the knowledge and practical skills of emergency department healthcare providers in regards to cricoid pressure, techniques and training. Seventy healthcare providers (46 nurses and 24 doctors) were recruited for this study, and of the 70 participants, 53% could identify the cricoid cartilage, and only 16% could identify the appropriate pressure needed on the initial attempt. Following two different methods of educating these healthcare providers on the appropriate appreciation of cricoid pressure, including instructional and biomedical, the lack of information retention at 4-6weeks was similar in both groups (Quigley & Jeffrey, 2007).

Endotracheal tube positioning is an important aspect of RSI, as improper placement can lead to serious consequences for the patient. If the ETT is inserted too far, bronchial intubation may occur and inadvertent extubation may result if the ETT is not

inserted to the proper depth. A commonly used method of positioning the ETT is to insert it until the desired and appropriate marking is at the upper incisors or lip. The general depth guideline for ETT insertion is 21cm at the lip for adult females and 23 cm at the lips for adult males (Evron & Weisenberg, 2007). Despite this 21-23cm insertion approach, accidental bronchial intubations may still occur due to individual variations. Tall patients and patients requiring excessive head extension may require insertion to as much as 24-25 cm at the lip. Conversely, in shorter stature women, the tube may only need to be inserted and secured at the 19cm marking. Proper placement is necessary to ensure placement in the middle of the tracheal, below the cords yet above the carina. During direct laryngoscopy the experienced laryngoscopist can position the ETT tip in the middle of the trachea placing the upper end of the cuff of a tube (size 7 or 8 ID) 2 cm below the vocal cords. According to Salem (2001), this will position the distal end of the tube approximately 4 cm from the carina. This maneuver should be attempted whenever intubation is performed under direct laryngoscopy (Salem, 2001).

Traditional clinical signs frequently used for endotracheal tube placement verification are direct visualization of the ETT passing through the cords, chest wall movement and auscultation of breath sounds with ventilation, and tube condensation with water vapor. The epigastrium should also be auscultated to rule out the presence of air entry with ventilation as this signifies esophageal intubation. Clinical tests used to verify proper ETT placement following intubation, when concerned about anatomic differences, include neck palpation for the presence of the ETT cuff and chest x-ray. Pulse oximetry for the detection of cyanosis and the identification of expired carbon dioxide in the exhaled gas via capnography or colormetric end-tidal carbon dioxide detectors are

important methods for verification of tube placement (Salem, 2001). A variety of clinical signs and technical aids are used for the identification of proper ETT placement, but not all will be accurate in every circumstance. It is the responsibility of those involved to understand and perform the tests appropriately and interpret the results accurately. Viewing the ETT pass through the cords during direct laryngoscopy is the only fool proof method of confirming tracheal intubation (Salem, 2001).

The detection of carbon dioxide in exhaled gas has become the gold standard for verification of proper tracheal tube placement. Failure to rapidly identify correct endotracheal tube placement versus esophageal placement can rapidly prove fatal. Two methods are currently readily available for end tidal carbon dioxide monitoring outside of the operating room and they include capnography and colormetric end-tidal carbon dioxide detectors. Colormetric end tidal carbon dioxide detectors are more commonly used for intubations that occur outside of the operating room. It is important to remember that these carbon dioxide detectors are reliable in the non-arrested patient. The interpretation of the colormetric end tidal carbon dioxide detectors requires caution in patients that have arrested as it may indicate circulatory arrest, inadequate resuscitation, or esophageal intubation. Grmec (2002) conducted a study that spanned from 1998 to 2001 and involved 378 patients that required emergency tracheal intubations. Grmec (2002) compared three methods for the proper placement and verification of endotracheal tube placement in emergency situations outside of the operating room. In this study, Grmec concluded that false positives are rare but can still occur with colormetric end tidal CO2 monitoring, particularly with the first few breaths due to the trapping of CO2 in the stomach from bag-valve-mask ventilation prior to intubation. Despite the risk for

false positives and false negatives, end tidal CO2 monitoring for RSI procedures outside of the operating room prove to be reliable and can differentiate between endotracheal and esophageal intubation if the EtCO2 tension is greater than 5mmHg or if there is an increase in the CO2 level with each ventilation cycle of approximately seven breaths.

Complications Related to Emergent Endotracheal Intubation

Securing a definitive airway in a struggling critically ill patient is a life saving measure undertaken by well meaning healthcare providers. Unfortunately, patients can and sometimes do experience further deterioration during this process. Critically ill patients incur a substantial risk for experiencing severe complications while undergoing emergent ETIs. In a retrospective study, Mort (2004) examined 3,035 critically ill patients who required emergent tracheal intubation. Two percent of these cases experienced cardiac arrest, of which 83% were associated with profound hypoxemia during the procedure. The intubation associated risks contributing to the incidence of cardiac arrest were identified as regurgitation, bradycardia, aspiration, and hypoxemia. This study was conducted over two different time periods, the first being 1990-1995 and the second from 1995-2002 (Mort, 2004). The rate of cardiac arrests between the time periods noted in the study was reduced by 50%. According to the author, this decline was likely due to improved access to advanced airway devices and to tube verifying devices which helped in the prevention of hypoxemia related cardiac arrests. In another study, Mort (2005) looked at ETI's from 1990-2001 involving 2,377 critically ill patients. The author concluded that ETI related cardiac arrests were increased significantly in those who experienced significant hypoxemia, regurgitation, aspiration, bradycardia, and other cardiac dysrhythmias (Mort, 2005). According to Mort (2004), "A detailed analysis of

intraoperative mishaps has shown that respiratory based complications during airway management, i.e., oxygenation and ventilation difficulties, account for nearly one third of all anesthetic deaths" (p.611). Anesthesia professionals who provide emergency airway management outside of the operating room often encounter patients with hemodynamic changes and airway complications, which can greatly increase patient morbidity and potentially mortality.

Schwarz et al. published an important study in 1995 and in this study, 297 tracheal intubations were observed by the author and the incidences of complications were documented. Table 2 summarizes the major findings from this article.

Table 2
Common Complications associated with RSI or ETI

Dental Trauma	Multiple Intubation Attempts
Difficult Intubation	Pneumothorax
Esophageal Intubation	Cardiac Dysrhythmias
Aspiration	Cardiac Arrest
Hypoxemia/Hypoxia	

Schwartz, D., Matthya, M., Cohen, N. (1995). Death and Other Complications of Emergency Airway Management in Critically Ill Adults: A Prospective Investigation of 297 Tracheal Intubations. *The Journal of the American Society of Anesthesiologist, Inc.*, 82(2).

Aspiration of gastric contents can and frequently does occur in critically ill patients needing emergency airways, often occurring even before tracheal intubation or arrival to the hospital. The rate of significant aspiration directly related to the intubation itself is unknown, but is thought to occur in up to 22% of RSIs. This high incidence may be attributed to repetitive intubation attempts (Ellis, 2007). A retrospective review by Mort (2004) of 2,833 patients who required emergency tracheal intubation showed a 1.9% incidence of aspiration when laryngoscopy attempts were repeated once or twice. Mort (2004) also found that an increased number of laryngoscopy attempts increased the

risk of aspiration overall. Three attempts or more increased the incidence to 22% (Mort, 2004).

Tracheal rupture is an iatrogenic injury related to ETI that can be life threatening. Although a rare incident, it warrants discussion so that healthcare providers may be suspect to all potential complications of RSI. Fan et al. (2004), in a case review, provided possible mechanisms of injury and also listed management suggestions. Factors contributing to tracheal rupture during emergent tracheal intubations include multiple laryngoscopy attempts, over inflation of endotracheal tube cuffs, and inadequate tube size to name a few (Fan, et al, 2004). Women have a higher risk of this complication due to tracheal membrane weakness and a smaller body size which places them at risk for having the endotracheal tube inserted too far relative to the short trachea (Fan et al., 2004).

Mort (2004) states that repeated laryngoscopy attempts can also contribute to patient mortality. According to Mort (1998) approximately 1 in 10 RSI procedures results in 3 or more attempts at intubation and these multiple laryngoscopy attempts are associated with an increased incidence of esophageal intubation, hypoxia, and regurgitation. Mort went on to state that the hemodynamic and airway related complications encountered in RSI procedures outside of the operating room are numerous and often lead to significant patient mortality and morbidity (Mort, 2004).

Bronchial intubation accounts for 2% of the adverse respiratory events that occur in adults following intubation. Schwartz et al. (1995) reported an incidence as high as 15.5%, with a higher frequency in women. Bronchial intubation can irritate the patient's

was developed by the author and provided to area emergency rooms, intensive care units, and anesthesia staff. The educational power point presentation covers the major aspects of the literature review including the indications, techniques, and complications of RSI outside of the operating room.

Evaluation Plan

Accompanying the power point is an evaluation form (see Appendix E) that participants are encouraged to complete and return through mail. Results will be compiled as they are received. The evaluation form targets the nursing population and elicits their feelings of competency and comfort in their assistant role in RSI following their viewing of the educational RSI DVD. See appendage A for the complete form.

Expected Results

The complications, indications, and current techniques were presented in the informational power point in an attempt to increase the knowledge and comfort level of those involved in RSI's outside of the operating room. After viewing the education power point, personnel involved in RSI should be able to identify the indications, complications and current techniques of RSI procedures. The personnel involved in the RSI should also be able to indentify needed equipment and medications and their usual dosages and side effects for procedure. The expected result of this project is that there will be an increase in knowledge in regards to RSI outside of the operating room. Increased knowledge will lead to increased preparedness by all involved, eventually leading to a more organized approach to RSI outside of the operating room and therefore will result in improved outcomes in patient care.

Implications for Nursing Practice and Education

Patients in need of an emergency airway and requiring RSI are generally the most acute patients nurses will have to care for. RSI is not a procedure that should be approached lightly as evidenced by the previous literature review and the noted complications that can and often do accompany the procedure. The nurses' priority is the care for that patient, which involves knowing and understanding the steps and medications involved with RSI, as well as the implications and complications associated with the procedure. An important implication for this educational tool is that it will be provided as a means of yearly education for staff of emergency rooms, intensive care units, and for other personnel who will be involved with the RSI process, especially those new to critical care areas. Education is an important tool that can be used to ensure appropriate care for the critically ill or injured patients requiring RSI.

Implications for Nursing Research and Policy

RSI may be required anywhere outside of the operating room, and are often emergencies which require expert knowledge and skill to be safely preformed, not only by the person performing the actual intubation, but also by those responsible for the patients care both before and after the procedure. An increasing aging population only suggests that our hospitalized patient population will be getting sicker and will have more complex needs, thus suggesting that there will be an increased occurrence of RSI outside of the operating room. Further nursing research in this area would benefit both the nursing profession and the patients they care for. Many hospitals have policies in place for Emergency Room departments and critical care transport programs, but outside of

will deteriorate during or following intubation. Some patient conditions may necessitate changes to the common techniques of RSI due to individual variations; therefore, it is imperative that those involved with the care of patients during RSI are familiar with the management of each special group of patients. Non-anesthesia providers who are involved in the RSI may not administer the medication or insert the endotracheal tube, but the ongoing care of the patient may be their responsibility. Prudent knowledge of the RSI procedure is critical to the well being of the patient.

airway and lead to bronchoconstriction, which can be a fatal complication. Bronchial intubation is easily resolved by pulling the ETT back to a depth just above the patient's carina, the bifurcation that separates the right and left main stems of the lungs. However, failure to recognize bronchial intubation can rapidly progress and lead to bronchoconstriction which is more difficult to treat and can prove to be fatal.

Overall, emergency tracheal intubations, including RSIs, in critically ill patients are associated with many potential difficulties and complications. According to Lebowitz (2006), "Tracheal intubation is the most commonly preformed procedure in the ICU that is associated with a significant incidence of morbidity and mortality" (p.2497). In a retrospective study by Schwarz et al. (1995), of the 297 intubations that were performed at a major teaching hospital, 11% of them required a second attempt, 8% were esophageally intubated, 4% of the patients aspirated, and 3% died as a direct result from complications related to the intubation attempt (Lebowitz, 2006).

Summary

Rapid sequence intubations, when performed appropriately by skilled healthcare professionals, provide the critically ill patient with a lifesaving airway and the potential for subsequent stabilization. For success, however, certain steps and techniques must be adhered to. Complications can and do occur. Healthcare professionals involved in this type of critical patient management must have a thorough understanding of this process.

Each individual healthcare member involved in the emergent ETI or RSI plays a significant role in ensuring patient safety. Expanding ones knowledge base is a

professional responsibility for all health care professionals. By continuing our education and expanding our knowledge we can improve patient safety and positively impact patient outcome.

CHAPTER III

INTRODUCTION

The indications, techniques, and complications of RSI that occur outside of the operating room must be understood by healthcare personnel who are directly involved in caring for patients requiring this procedure. Evidenced based healthcare provides healthcare personnel with a means to integrate continuing education and research into their daily practice. Evidence based medicine or research involves the process of acquiring, systematically reviewing, appraising and applying research findings to deliver optimal clinical care to patients (Das & Malick, 2008). This independent project includes a thorough literature review of the most current evidence regarding RSI outside of the operating room, including the complications and indications.

Target Audience

This independent study project is aimed towards adult learners who are also healthcare professionals with the basic knowledge of airway anatomy, airway management, as well as having completed BLS and ACLS. The primary target audience therefore includes CRNAs, student registered nurse anesthetists, registered nurses, paramedics, emergency medical technicians, and respiratory therapists.

Methodology

A thorough review of the literature regarding RSI indications, techniques, and complications was undertaken. A narrated power point presentation (see Appendix B)

those areas, the policies are often vague, if present at all. Nursing research in this area could provide for concrete evidence of the nursing role and therefore suggest such guidelines for policies to be instituted.

Clear and concise policies should be instituted and available for RSI occurring outside of the operating room, for example, those occurring in the intensive care unit. Accurate research guided policies can help to ensure that personnel involved in RSI's outside the operating room will be working as a cohesive unit which in turn will result in improved patient care and outcomes.

Summary

Evidence based research is an essential part of clinical practice, as is continuing education. To be most beneficial, evidence based practice should be used judiciously in the appropriate clinical setting. According to Malick (2008), "Provision of evidence-based healthcare is the most ethical way to practice as it integrates up-to-date patient-oriented research into the clinical decision making to improve patient's outcomes" (p.536). Continuing education for RSI can only help better prepare those who are involved in the procedure by increasing their knowledge base in regards to proposed medications and their side effects, complications and indications.

The corner stone of emergency airway management is RSI. RSI performed outside of the operating room may be more challenging than within the operating room due to the critical condition of the patient, the training and experience of the clinician, the equipment available, and the personnel involved. In some clinical situations, the patient

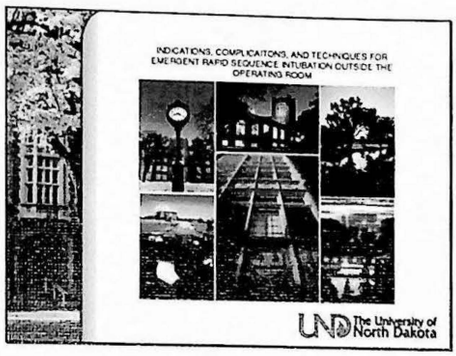
APPENDICES

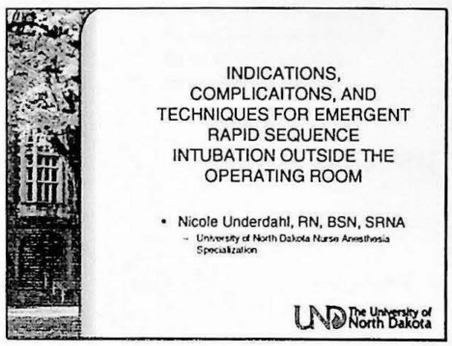
Appendix A

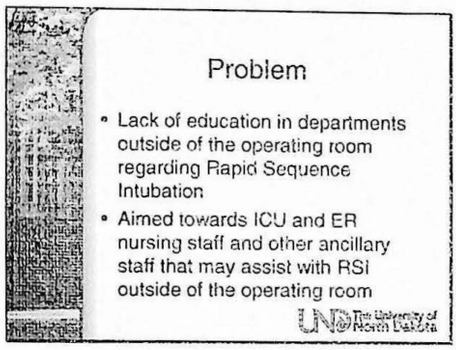
A Quick Guide for Commonly used medications for RSI

Drug	Dosage	Onset	Duration	Indication	Possible Side Effects or Cautions
Lidocaine	1.5 mg/kg IV 2-3 minutes before intubation	45-90 sec	10-20 min	To diminish hypertensive response, to reduce airway reactivity, to decrease intracranial hypertension	Hypotension
Fentanyl	2-3 μ/kg IV over 2-3 min	Immediate	30 min-1 hour	Provides sedation and analgesia	Hypotension, chest wall and masseter rigidity, bradycardia
Succinylcholine	1.5mg/kg IV	30-60 sec	5-15 min	Unless contraindicated use as default paralytic	Familial or personal history of malignant hyperthermia, difficult intubation or mask ventilation, uncontrollable hyperkalemia, myopathy, chronic neuropathy, stroke; denervation illness or injury, crush injury >3d; sepsis >7d; severe burns>24 hr.
Rocuronium	0.6-1mg/kg	45-60 sec	45-70 min	When unable to use succinylcholine	Difficult intubation and ventilation, aminosteroid NMB allergy
Etomidate	0.3 mg/kg if stable IV 0.15mg/kg if unstable IV	30-60 sec	5-30 min	Multitrauma, Existing hypotension	Decreases focal seizure threshold, inhibits cortisol synthesis
Propofol	2mg/kg IV if stable, 0.5mg/kg IV if unstable	9-50 sec	3-10 min	Status epilepticus, isolated head injury	Lecithin allergy, hypotension

Appendix B


INDICATIONS, COMPLICAITONS, AND TECHNIQUES FOR EMERGENT RAPID SEQUENCE INTUBATION OUTSIDE THE OPERATING ROOM
UND The University of North Dakota


INDICATIONS, COMPLICAITONS, AND TECHNIQUES FOR EMERGENT RAPID SEQUENCE INTUBATION OUTSIDE THE OPERATING ROOM
• Nicole Underdahl, RN, BSN, SRNA
– University of North Dakota Nurse Anesthesia Specialization
UND The University of North Dakota


Problem
• Lack of education in departments outside of the operating room regarding Rapid Sequence Intubation
• Aimed towards ICU and ER nursing staff and other ancillary staff that may assist with RSI outside of the operating room
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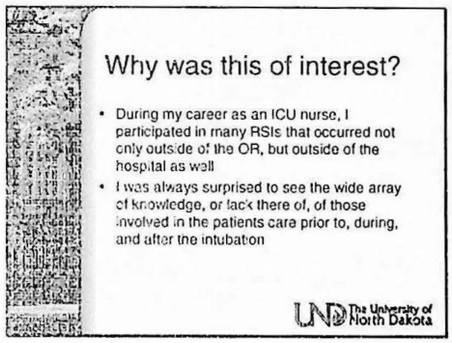
Why was this of interest?
• During my career as an ICU nurse, I participated in many RSIs that occurred not only outside of the OR, but outside of the hospital as well
• I was always surprised to see the wide array of knowledge, or lack there of, of those involved in the patients care prior to, during, and after the intubation
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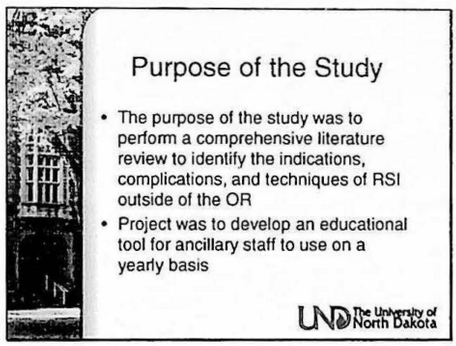
Purpose of the Study
• The purpose of the study was to perform a comprehensive literature review to identify the indications, complications, and techniques of RSI outside of the OR
• Project was to develop an educational tool for ancillary staff to use on a yearly basis
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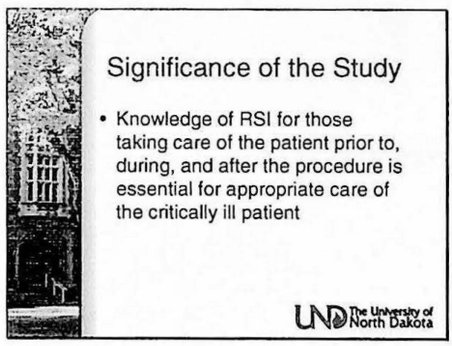
Significance of the Study
• Knowledge of RSI for those taking care of the patient prior to, during, and after the procedure is essential for appropriate care of the critically ill patient
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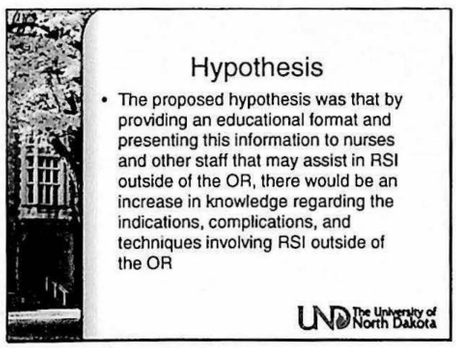
Hypothesis
• The proposed hypothesis was that by providing an educational format and presenting this information to nurses and other staff that may assist in RSI outside of the OR, there would be an increase in knowledge regarding the indications, complications, and techniques involving RSI outside of the OR
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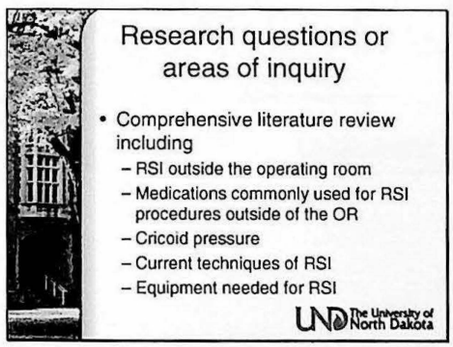
Research questions or areas of inquiry
• Comprehensive literature review including
– RSI outside the operating room
– Medications commonly used for RSI procedures outside of the OR
– Cricoid pressure
– Current techniques of RSI
– Equipment needed for RSI
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Methodology

- Comprehensive literature review performed regarding indications, complications, and techniques of RSI outside of the OR
- Information compiled into an educational power point and a narrated DVD was prepared and sent out to outlying facilities and local ICU and ER
- An evaluation form was provided for additional feedback regarding the significance of this project to be completed at the viewers leisure

Findings

- No research in the area of nursing education and RSI
- Plenty of research on medical doctors knowledge of RSI and evaluation of their skills on performing the RSI

Findings

Indications for RSI

- Hemodynamic instability
- ARDS
- Cardiogenic shock
- Sepsis
- Trauma
- Cardiac arrest or other cardiovascular pathology
- Drug overdose

Complications

- Dental Trauma
- Difficult Intubation
- Esophageal Intubation
- Aspiration
- Multiple Intubation Attempts
- Pneumothorax
- Cardiac Dysrhythmias
- Cardiac Arrest
- Hypoxemia/Hypoxia

Techniques

Preoxygenation

- Should be started with 100% oxygen approximately 3 minutes prior to induction with medication, preferably 5 minutes before the administration of NMB
- One study argued that preoxygenation may not be beneficial to the critically ill patient who is already experiencing hypoxia or respiratory failure

Induction medications

- Lidocaine
- Fentanyl and morphine
- Midazolam
- Etomidate
- Propofol
- Succinylcholine
- NDMB: rocuronium

Findings

ETT placement confirmation

- Direct visualization of the ETT passing through the cords
- Chest wall movement and auscultation of breath sounds with ventilation
- Tube condensation with water vapor
- Detection of carbon dioxide in the exhaled gas either via $EtCO_2$ monitor or a colormetric CO_2 detector

Cricoid pressure

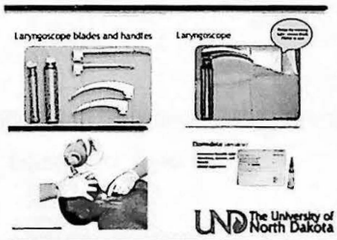
- Without cricoid pressure there is little to no gastric distention with insufflation pressures <15mmHg
- With cricoid pressure gastric distention can occur with pressures >45mmHg
- Not a benign procedure and can have serious complications
- For nonanesthesia personnel, often preformed incorrectly and inconsistently

Educational DVD

RSI? Is there a difference?

Rapid sequence Intubation · Rapid sequence Induction

Excerpts from the educational DVD



Results

- A voluntary evaluation form was sent with the DVD's to the various outlying facilities to be completed at the viewers leisure
- The expected result is that there will be an overall increase in the knowledge base regarding RSI for those caring for patients requiring emergency airways outside of the operating room

Appendix C

INDICATIONS, COMPLICAITONS, AND TECHNIQUES FOR EMERGENT RAPID SEQUENCE INTUBATION OUTSIDE THE OPERATING ROOM

Nicole A. Underdahl, BSN,RN, SRNA
University of North Dakota
Nurse Anesthesia Specialization
2009

Purpose and Disclaimer

- The purpose of this educational power point presentation is to enhance the knowledge of health care providers of the common indications, techniques, and complications associated with RSI that occurs outside the operating room.
- This brief overview consists of rapid sequence intubation concepts for adults only, and does not discuss parturients, pediatrics, or difficult airway scenarios
- This is a short overview of some of the more popular ideas concerning rapid sequence intubation and should not be used solely as a basis for a rapid sequence intubation protocol. Please consult your department policy on rapid sequence intubations.

Why is this important?

- Are you a new healthcare provider in a critical care area?
- Have you participated in a rapid sequence intubation and wish that you knew more about the equipment or medications used?
- Have you participated in or witnessed a rapid sequence intubation where staff were not properly prepared in regards to equipment or medication?
- Have you taken care of patients after a rapid sequence intubation and wondered what were some of the side effects from the medications used?
- Have you witnessed complications after an intubation and wondered if they were caused by the intubation?

RSI? Is there a difference?

- Rapid sequence ***Intubation***
- Rapid sequence ***Induction***

Yes there is a difference

- **RSI- Rapid Sequence Intubation**
  - Used by healthcare providers outside of the operating room to rapidly establish a definitive airway for those patients falling into the following categories
    - Trauma
    - Full stomach (including patients with Diabetes, obstetrics, narcotic use)
    - "Any suspicion of a "full stomach" requires the RSI approach to securing a definitive airway
- **RSI-Rapid sequence Induction**
  - Used by anesthesia providers for induction of anesthesia in the operating room to establish an airway for a surgical procedure falling into the following categories
    - Trauma
    - Obstetrics
    - Full stomach
    - Diabetes
    - Patients on long term narcotics
    - Any condition leading to suspicion of a full stomach

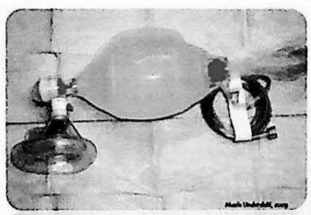
Indications for RSI

- Trauma
- Medical- for example:
  - Diabetes Mellitus
  - Bowel obstruction
- Full Stomach
- Obstetrics
- Narcotic use
- Any state that possible will slow down the emptying of the digestive tract and predisposing the patient to an increased risk of aspiration

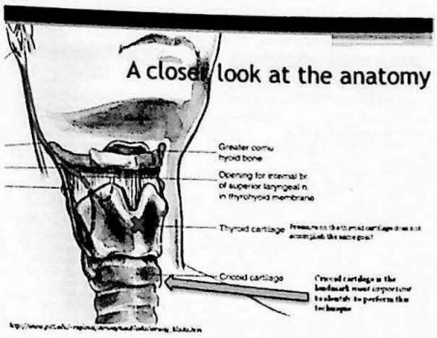
Equipment needed for RSI

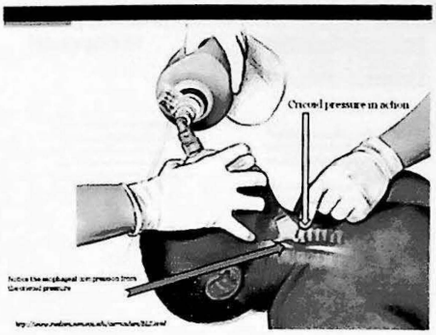
- Suction
- Ambu bag and mask
- Oxygen source
- Appropriate medications
- Running IV
- Oral Airway
- Oral or Nasal gastric tube
- Tape to secure Endotracheal tube
- Proper size ETT , stylet, and 10-12ml syringe
- Gloves and eye protection
- Laryngoscope with working light
- Stethoscope

Preoxygenation



A closer look at the anatomy





Medications commonly used for RSI and their potential side effects or associated complications

- Preinduction/*Pretreatment* Agents
  - Midazolam
  - Fentanyl
  - Lidocaine
- Induction Agents
  - Propofol
  - Etomidate
- Neuromuscular Blocking Agents
  - Succinylcholine
  - Rocuronium

Lidocaine

- Lidocaine is an amide local anesthetic agent used as a *pretreatment* agent in many RSI procedures

Dosage	Onset	Duration
1.5 mg/kg	45-90 seconds	10-20 minutes

Indications
-to blunt the responses to laryngoscopy
- Reactive airway disease- laryngoscopy can cause reflex bronchospasm
- Elevated ICP-laryngoscopy causes a reflex rise in ICP in patients with an elevated ICP (i.e. head injury)
- Hypertension

Contraindications
- A toxic side effect of lidocaine is that it may produce seizures with larger than recommended dosages
- The safe maximum dose for lidocaine is 4mg/kg, which is a dose much greater than required for RSI
- Lidocaine can cause hypotension

Midazolam *(Versed)*

Dosage	Onset	Duration
0.1-0.3 mg/kg	30-60 seconds	15-30 minutes

- Midazolam is a benzodiazepine that produces sedation, amnesia, hypnosis, and muscle relaxation in a dose dependent fashion.
- Midazolam also has antianxiety and anticonvulsant effects.
- Midazolam has a rapid onset of action and short duration of action and is used as a *pretreatment* agent in many RSI procedures

- *Indications*:
  - Promote amnesia and sedation
- *Contraindications*:
  - May require adjustment of the dosage in the hemodynamically compromised patient due to dose related reduction in SVR and myocardial depression

Fentanyl *(Sublimaze)*

Dosage	Onset	Duration
3 mcg/kg	Immediate	30 minutes-1 hour

- Fentanyl is a synthetic opioid with high lipid solubility which leads to a rapid onset of action
- Fentanyl is a *pretreatment* agent used in many RSI procedures
- Fentanyl has a lack of direct myocardial depression
- Fentanyl is used for the suppression of the stress response to laryngoscopy
- Fentanyl also lacks a histamine release.

- *Indications*:
  - To suppress the stress response related to laryngoscopy
- *Contraindications*:
  - does not produce amnesia
  - dose dependent respiratory depression
  - Bradycardia
  - Hypotension related to bradycardia
  - Skeletal muscle rigidity and myoclonus
  - modest increases in ICP

Propofol *(Diprivan)*

Dosage	Onset	Duration
1.5-3 mg/kg	15-45 seconds	5-10 minutes

- Propofol is a powerful intravenous hypnotic agent to be administered only by those with advanced airway and intubation skills and is often used by anesthesia practitioners, both in the operating room and for RSI outside of the OR.

Indications
- To induce a hypnotic state for intubation that has a more rapid and complete wake up with little residual (CNS) effect
- Anticonvulsant properties
- Decreases ICP

Contraindications / Side effects
- Patients with egg, soybean, or lecithin allergies
- Hypotension
- Chemical makeup can support bacterial growth

Etomidate *(Amidate)*

Dosage	Onset	Duration
0.3 mg/kg	15-45 seconds	3-12 minutes

- Etomidate is a hypnotic agent that has earned a place in many RSI protocols for its ability to be used with cardiovascularly unstable patients intravenous hypnotic agent

Indications
- To induce a hypnotic state for intubation that has little effect on the cardiovascular system, making it ideal for hemodynamically unstable patients

Contraindications / Side effects
- Decreases focal seizure threshold
- Adrenal suppression inhibits cortisol synthesis (should be avoided in the septic patient)
- Can cause myoclonus, dystonia, and tremors with administration
- May produce a burning sensation in the patients IV with administration

Succinylcholine

Dosage	Onset	Duration
1.5 mg/kg	30-60 seconds	5-13 minutes

- ***Use as default paralytic unless contraindicated !***
- Will see fasciculations will this medication
- *Side effects*
  - Bradycardia (more likely in children and adults receiving a second bolus
  - Muscle pains (related to fasciculations)
  - ↑ICP and Intraocular pressure
  - Transient ↑ in serum K of 0.5-1.0 mEq/L
    - Enhanced by trauma, burns, denervation injury and unrecognized muscular dystrophy in male children

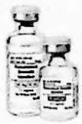
Indications
- To rapidly induce muscle paralysis and ease intubation

Contraindications
- Familial or personal history of
  - malignant hyperthermia
  - difficult intubation or mask ventilation
  - uncontrollable hyperkalemia
  - myopathy
  - chronic neuropathy
  - stroke
  - deterioration illness or injury
  - crush injury
  - sepsis
  - severe burns 24 hr
  - Pseudocholinesterase deficiency

Rocuronium

Dosage	Onset	Duration
0.6-1 mg/kg	45-90 seconds	45-70 minutes

- Rocuronium is a non-depolarizer neuromuscular blocking agent that produces intubating conditions within 60 seconds when administered in doses of 1mg/kg

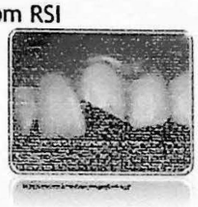


Indications
- To induce muscle paralysis and ease intubation when succinylcholine is contraindicated

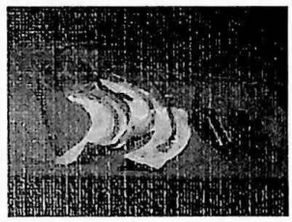
Contraindications / Side effects
- allergies to amino steroidal NMB
- Anticipation of difficult airway

Complications from RSI

- Dental Trauma
- Difficult Intubation
- Esophageal Intubation
- Aspiration
- Multiple Intubation Attempts
- Pneumothorax
- Cardiac Dysrhythmias
- Cardiac Arrest
- Hypoxemia/Hypoxia



Laryngoscopy and intubation in a controlled setting



Teamwork promotes improved outcomes for those we care for!

Evaluation:

- Please take the time to complete the short evaluation that was provided to you and return to your department manager.

Appendix D

To whom it may concern:

Hello. My name is Nicole Underdahl and I am currently a graduate student attending the University of North Dakota specializing in nurse anesthesia. I have been a registered nurse for 13 years, 10 of which were spent in the ICU. Additionally, I was a flight nurse for the North Star CriticAir helicopter service out of Minot, ND for 7 of those years. My background includes numerous patient situations requiring the provision of rapid sequence intubation, none of which occurred in the controlled environment of the operating room.

My independent study project was created and based on my own experiences with rapid sequence intubations outside of the operating room. As a nurse working in the critical care area, I, like each of us, wanted only the best possible outcome for every patient that I cared for, including those patients requiring emergent airway intubation.

I am offering an educational DVD for your use as a tool for advancing the knowledge of rapid sequence intubation among your licensed staff. Feel free to use it at your discretion and to make it available to your employees if you desire. Do keep in mind that this DVD is only an educational tool provided by a student to assist your staff in learning more about rapid sequence induction. It is not intended to be used as the sole source of information regarding this procedure.

I have included evaluation forms with self addressed stamped envelopes and would welcome any feedback you are willing to provide. Thank you.

Sincerely,

Nicole Underdahl, RN, BSN, SRNA
University of North Dakota
Nurse Anesthesia Specialization

Appendix E

Rapid Sequence Intubation Feedback Form

Thank you for taking the time to view this educational presentation. I truly hope that your experience was a pleasant one. I'd like to know if you felt this will help you in caring for your patients, or if it will help you in future practice. I appreciate you taking the time to view the presentation and filling out this evaluation form.

Please take a moment to fill out the following form and place it in the large manila envelope. Your honest answers will help me evaluate this learning tool.

Sincerely,
Nicole A. Underdahl, SRNA
University of North Dakota
Nurse Anesthesia Specialization

RSI: COMPLICATIONS, INDICATIONS, AND TECHNIQUES

I had a basic knowledge of RSI prior to viewing the presentation.

☐No ☐Yes Explain:

After viewing this presentation, I have a greater knowledge of RSI.

☐ No ☐Yes Explain:

After viewing this presentation I feel I would be able to assist a skilled provider in an emergent RSI.

☐ No ☐Yes Explain:

After viewing this presentation I, as a skilled provider, could carry out an emergent RSI.

☐No ☐ Yes Explain:

I feel that by watching this presentation, I will be more prepared to:

- Recognize RSI indications. ☐No ☐ Yes
- Understand intubation medications, side effects, and common dosages. ☐ No ☐Yes
- Recognize complications that can arise from RSI. ☐ No ☐ Yes
- Assist with or carry out a RSI, including understanding of various techniques and equipment needed. ☐ No ☐Yes

Overall, viewing this presentation will strengthen my current background knowledge in the caring for patients requiring RSI. ☐ No ☐ Yes

PLEASE INDICATE YOUR PROFESSION

☐RN ☐LPN ☐CRNA ☐SRNA ☐MD/DO ☐Resident ☐Student nurse

☐Paramedic ☐EMT ☐Other (please specify)_____

PLEASE INDICATE YOUR AREA OF WORK OR SPECIALTY

☐Critical Care ☐Emergency Room ☐Acute care (Med/Surg)

☐Surgical Suite ☐Anesthesia ☐Nursing Education

☐ Other (please specify)_____

Please include any comments or suggestions that you'd like to share.

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