

Rapid Sequence Induction for Prehospital Providers

R Pousman

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Abstract

I. INTRODUCTION

Securing and maintaining a patent airway reserves the highest priority when caring for critically ill or injured patients. When airway intervention is required it should be performed in an expedient and organized fashion by an experienced individual with the goal of providing a definitive airway safely, minimizing any possible complications. Rapid sequence induction or RSI, has just this goal in mind and to be performed successfully, takes experience, a thorough understanding of its indications, contraindications and limitations, and a working knowledge of the physiology and pharmacology of agents used. RSI involves the use of drugs to assist in intubation. This course will review how to recognize airway or ventilatory compromise, how to manage the problem, emphasize the proper use of RSI with a focus on clinical skills, and discuss the pharmacology and indications of the various agents employed with this technique.

II. BRIEF HISTORY

Since its introduction in the late 1970's, RSI has, and continues to draw a great deal of controversy from the medical community. Partly this controversy stems from individuals who are not familiar with their particular EMS system's competence and feel that this task cannot be safely performed in a non-physician's hands, that paramedics are "cowboys" running wild in the streets, and most of all, it is bred from ignorance of the facts and fear of losing control. Numerous studies have proven that in experienced hands, RSI can be safely performed in the prehospital setting. Some studies have tried to demonstrate that nasal intubation is superior to pharmacologic-assisted oral intubation, and although nasal intubation may be quicker in some providers hands, RSI has a higher initial success rate consistently.

Of utmost importance, a highly organized and structured physician-based quality assurance program is behind every

successful EMS system that utilizes RSI in their airway management protocols. If RSI is to be adopted by an EMS system, a considerable amount of cooperation is necessary from various parties in that particular system. For instance, the local emergency room directors should be consulted and their concerns and comments addressed, a motivated and cooperative operating room and anesthesia department is invaluable, for it is here where the various skills and experience with the pharmacologic agents to be used can be had. The operating room is also useful to perform monthly and yearly quality skills assessments needed for every participant practicing this technique.

No matter what the controversy may be, the truth of the matter is that until physicians provide the prehospital care, it is in everyone's best interest to insure that our existing providers are highly trained and skilled.

III. AIRWAY ANATOMY

The airway is divided into 3 regions; the upper airway, the middle airway, and the lower airway. Each is comprised of separate structures.

- Upper Airway: The upper airway can be considered as beginning with the face and the facial skeleton. Therefore, the mandible and maxilla are considered components of the airway. This is important to realize as facial fractures are truly airway injuries as well. Also within this region is the nasopharynx and the oropharynx which aid in conducting air to the lower airways, humidifying gases, and clearing debris.
- Middle Airway: Principally composed of the larynx located midline in the neck. It is fairly vulnerable to injury however, it is relatively well protected from its two muscular lateral sides and the vertebral column posteriorly. The mandible

also adds some anterior protection as well. The larynx is comprised of cartilage of which the thyroid and cricoid are major components. Within the larynx are situated the vocal cords. This region is narrow and edema, secretions, or foreign bodies can compromise airway patency quickly.

- **Lower Airway:** The trachea delineates the middle and lower airways as it exits the neck and enters the chest. It is made up of incomplete cartilage rings anteriorly that are open posteriorly and held together by elastic-muscle tissue posteriorly. It travels in the chest and ends as the airway divides into the right and left mainstem bronchi. The trachea is relatively well protected, however, injury can occur from blunt trauma to the chest, primarily decelerating injuries, as well as from penetrating injuries.

IV. AIRWAY MANAGEMENT

Providing oxygenated blood to the brain and various tissues is vital to the preservation of life. Inability to prevent or reverse hypoxemia will quickly lead to death. The rapid assessment and recognition of a compromised airway and providing a definitive means for ventilation are the first priority. Supplying oxygen and allowing carbon dioxide removal are crucial, even more so in the patient with head trauma.

A. RECOGNITION

AIRWAY

Look for signs of airway compromise. These include tachypnea, evidence of increased effort such as use of accessory muscles of respiration; (sternal retractions, use of scalene muscles, or diaphragmatic or paradoxical breathing), nasal flaring, difficulty handling oral secretions. Agitation; an agitated patient may be hypoxic and should be thought to be until proven otherwise. (Not all agitation is due to intoxication.) Obtunded or lethargic patients may be so because CO₂ retention. Cyanosis is another sign and is indicative of poor oxygenation. Look for cyanosis of the digits and nail beds and also around the mouth (circumoral). Look at the neck for evidence of tracheal deviation or subcutaneous emphysema, which may alert to impending airway compromise. A quick inspection of the oral cavity for evidence of foreign body should also be made as well as the presence of impaired airway - protective reflexes.

Listen for evidence of airway compromise. Listen for harsh,

crowling, respiratory efforts also known as stridor. If the patient can speak, listen to the quality of their voice; is it clear and understandable? Or is it garbled or hoarse? These may indicate partial upper airway obstruction or the presence of a laryngeal injury. A talking patient reassures you that their airway is presently patent as well as an adequately perfused brain.

VENTILATION

Look for signs of ventilatory impairment. Ventilation involves the airways and muscles of respiration as well as a functioning CNS. Therefore, an unobstructed airway will be of little benefit if proper ventilation is not taking place. Observing for symmetrical rise and fall of the chest helps assume adequate ventilation. Paradoxical movement, as in a flail chest or sternum, not only will compromise oxygenation but ventilation also. Abdominal or diaphragmatic breathing, as seen in cervical spinal cord injury, will affect ventilation as well as oxygenation too. Labored respirations are another sign of possible impending failure. Agitation, somnolence, or unresponsiveness may be caused by CO₂ retention secondary to impaired ventilation.

Listen for evidence of ventilation. Listen to the chest, bilaterally, for proper air exchange. Symmetrical, equal , breath sounds aid in reassuring adequate ventilation. Absent or diminished breath sounds may indicate a pneumothorax, fluid collection, or other thoracic conditions that impair adequate gas exchange. The quality of the breath sounds may also aid in diagnosis. Wheezing, primarily on exhalation, may represent bronchospasm as seen in asthma. Upper airway obstruction secondary to foreign body or excessive secretions/blood will also affect ventilation and should be actively sought.

The wide use of pulse oximetry also aids in rapidly determining adequate oxygenation.

B. MANAGEMENT.

The basic tenet in airway management is a quick and accurate determination of adequate airway patency and ventilation, therefore, management should be performed in the same fashion. Supplemental oxygen should be placed on all patients. The proper equipment should be readily available and functioning correctly. (Suction apparatus, oxygen canister full, AMBU bag with mask, various sized oral and nasal airways, endotracheal tubes, laryngoscope with various size blades and functioning lights, as well as a back-up means of securing the airway.) Management

techniques can be divided into methods to improve oxygenation and ventilation, maintain airway patency, and ultimately provide a definitive airway.

1. OXYGENATION AND VENTILATION

The importance of proper oxygenation cannot be overemphasized. In order for tissues to function correctly, they require an oxygen - rich environment. Oxygen is supplied either by nasal cannula or by facemask (nonrebreather or AMBU) at a concentration of 100%. When administered by facemask, the flow rate should be high enough to maintain a filled reservoir, usually delivered at a rate of 10 - 12 liters/minute. Face masks should be tight fitting to ensure proper delivery and minimize leaks. Pulse oximetry aids in the determination of adequate oxygenation, however, limitations of this technique exist in certain situations, (hypothermia, excessive movement, ambient light interference, anemia)

Providing adequate ventilation is undoubtedly the most important intervention that must be mastered by the prehospital provider. This can be accomplished by facemask either by one person or two, or via mouth - to - mask or bag - to - mask. When one person is required to provide ventilation, maintaining a tight mask fit is difficult to accomplish. This may be better performed by using mouth - to - mask or, when another rescuer is available, with two person ventilation; one rescuer holds the mask in place with two hands while the other maintains the bag. Gentle, even pressure should be applied to the bag when ventilating and symmetrical chest wall movement should be observed. Avoidance of using excessive force when ventilating helps protect from creating gastric distention and subsequent regurgitation.

Aspiration of stomach contents or oral secretions and/or blood poses a risk to the patient with impaired airway protective reflexes, (head injured, intoxicated, etc.). To help protect against this, the use of cricoid pressure should be used whenever ventilating a non-intubated patient. This involves identifying the cricoid cartilage and applying firm, continuous, downward pressure to help occlude the esophageal lumen and impede the regurgitation of stomach contents and/or aspiration of pooled oral secretions.

2. AIRWAY MAINTENANCE

Maintaining a patent airway is critical if adequate oxygenation and ventilation is to occur. There are many alternatives to accomplish this.

a) Chin lift / jaw thrust

This maneuver helps alleviate the common occurrence of a prolapsed tongue that is displaced backwards and obstructs the upper airway. The chin is displaced forward by placing the fingers of one hand under the mandible while gently lifting up and using the thumb of the same hand to open the mouth. It is important not to place the fingers on the chin itself, as this could close a partially open airway.

The jaw thrust is performed by utilizing both hands. The fingers are placed behind the angles of the mandible, one hand on each side, and then the mandible is lifted forward. These techniques will allow the tongue to be displaced anteriorly along with the mandible to which it is attached. Obviously, any foreign bodies seen should be promptly removed.

b) Nasal or Oropharyngeal Airway

The use of these airways aid the rescuer in providing airway patency in both the spontaneously breathing patient as well as the assisted patient. Nasal airways are preferred in the responsive patient with intact airway reflexes for they are less stimulating and less likely to induce vomiting. They should be lubricated prior to insertion in the most patent nostril and must never be forced. The oropharyngeal airway is used as a means to displace the tongue anteriorly and remove it from obstructing the pharynx primarily in the unresponsive patient. It can be placed with its concavity directed towards the palate and then rotated 180 degrees as the soft palate is encountered. The use of a tongue depressor to facilitate placement is another alternative. Care must be taken as to not further push the tongue backwards and further occlude the airway.

c) Adjunctive Devices - The Laryngeal Mask Airway & The Combitube

THE LARYNGEAL MASK AIRWAY

The laryngeal mask airway or LMA, is a device introduced in England in the 1980's that is gaining popularity in the US. It is primarily used in controlled settings such as for outpatient surgery in the operating room but has recognized utility in providing an airway in difficult situations. The LMA is composed of a silicone rubber "mask" with an inflatable outer rim, that has an opening at its distal end covered by a "grille". It is reusable, requiring steam sterilization. The mask is connected to a plastic tube with a standard 15mm adapter for which to attach an AMBU bag or

breathing circuit. Prior to insertion, the air is completely removed from the cuff of the mask and the posterior surface is lubricated. The LMA is inserted blindly, with a tongue blade for assistance, most commonly. It is inserted with the opening or “grille” side facing the tongue and with the black indicator line of the plastic tubing towards the teeth or palate. It is advanced until resistance is felt then the “mask” is inflated. A characteristic elevation or slight protrusion of the tubing out of the mouth is usually seen as well as a fullness in the neck once the mask is inflated. These findings, as well as auscultation of breath sounds, rise and fall of the chest with ventilation, and the appearance of end tidal CO₂, are used for confirmation of correct placement. The LMA, when properly placed, forms a seal around the glottic opening, with its tip at the upper esophagus. This provides a relatively non-invasive means of providing ventilation.

THE ESOPHAGEAL -TRACHEAL COMBITUBE

The esophageal - tracheal Combitube (Combitube) is a modification and advancement of the older esophageal obturator airway or EOA. The Combitube is comprised of two separate, clear polyvinyl chloride tubes, fused together longitudinally. One tube is patent while the other is blind. The blind tube is longer than the patent tube and is color coded blue on its more proximal end as is its pilot balloon. Two inflatable balloons are located on the tube; one proximal latex 100 cc balloon that functions as the oropharyngeal balloon, and a more distal conventional 15 cc PVC balloon. Between the balloons, on the blind ended tube, are eight small perforations. Each tube has a standard 15 mm connector on its proximal end for connection to a breathing apparatus. Like the LMA, the Combitube is placed blindly. It can be lubricated prior to insertion, with avoidance of occluding the perforations, however, this is not mandatory. Both balloons are checked for any defects and then deflated. The patient’s tongue and mandible are grasped gently with the thumb and the forefinger and pulled forward. A laryngoscope may be used solely to aid in retracting the tongue. The Combitube is then inserted until the teeth are located between two black lines located on the proximal portion of the tube. Once inserted the proximal oropharyngeal balloon is inflated first with approximately 100 cc of air from the 140 cc syringe supplied. The Combitube may protrude slightly at this point. This oropharyngeal balloon functions as an anchor as well as occluding the proximal airway by forming a “seal” between the palate and the tongue. Next, the distal balloon is inflated with 10 - 15 cc of air. Since approximately 95 % of the time,

the Combitube is placed in the esophagus, the “blue” or blind lumen is ventilated first. This lumen is blocked distally which forces air out of the perforations and against the oropharyngeal balloon.

If the tube is placed in the esophagus, the distal cuff seals the esophagus and air will travel down the trachea, and breath sounds should be heard over the chest and not the stomach when this lumen is ventilated. If no breath sounds are detected and there isn’t any chest expansion with ventilation via the blind lumen, then tracheal placement, the less likely occurrence, is assumed and ventilation should now be switched to the patent, shorter lumen. If the Combitube is placed in this fashion, it then functions as a standard endotracheal tube. Placed in the more common esophageal position, the stomach and its contents can be evacuated with the supplied suction catheter. The Combitube is designed for patients 5 feet tall or larger and until recently, had only come in one size. Its use is contraindicated in patients with an intact gag reflex, known esophageal disease, history of ingestion of caustic material, or presence of upper airway obstruction.

**** Aspiration Risks:** The devices mentioned thus far will help establish an airway and enable effective oxygenation and ventilation however, they do little if nothing to guard against pulmonary aspiration of gastric contents. This is a very real risk that can have devastating complications if it occurs, especially in the emergency patient population. Therefore, an attempt to establish a definitive airway should be made.

D.) GUM ELASTIC BOUGIE (GEB)

The gum elastic bougie (GEB) or Eschmann catheter is a flexible piece of plastic about 2 feet long with a slight 45° angle on it’s end. This device is helpful when an anterior larynx is encountered and there’s difficulty in visualizing and/or intubating the larynx. The GEB can be placed through the vocal cords with the use of laryngoscopy and an ETT “railroaded” over it, thus using it as a stylet. When the GEB is properly placed in the trachea, a characteristic “clicking” sensation is felt as it advances over the anterior tracheal cartilaginous rings. It’s use is becoming more common in prehospital airway protocols for difficult airway encounters. It is simple to use, doesn’t require any additional training, and can quickly turn a potential disaster into a success.

E.) DEFINITIVE AIRWAY

A definitive airway is meant to represent an endotracheal

tube (ETT) that is placed in the trachea, past the vocal cords. A balloon, located distally, serves to protect against aspiration when inflated. The airway can be placed orally, nasally, or surgically in the form of a cricothyroidotomy or tracheostomy. The decision to place a definitive airway is based on clinical judgment and the understanding that a stable patient may deteriorate rapidly requiring frequent reassessment of their airway, ventilatory, and neurologic status as well as vital signs. Common indications for intubation include;

1. decreased level of consciousness (Glasgow Coma Score ≤ 8) at risk of increased intracranial pressure and need for hyperventilation,
2. patients at risk of aspiration secondary to impaired airway protective reflexes,
3. massive facial fractures/injuries, burn patients with risk or evidence of inhalation injury,
4. apnea,
5. failure to maintain a patent airway and oxygenation by other means.

F.) AIRWAY ASSESSMENT

Prior to undertaking the placement of a definitive airway, one should attempt to determine the likelihood of a potential difficult airway with inability to ventilate. There have been numerous methods used to assess this potential however, they are directed at the more controlled environment and may be difficult if not impossible to utilize in the field. Nonetheless, an attempt should be made.

If possible, have the patient open their mouth as wide as they can and stick out their tongue. The view of the pharyngeal structures seen is classified as class I - IV, class I is the best view and class IV is the worst view. This has been proposed as indicating the possibility of which ease of intubation may be expected, but respect that there is great variability. The actual view seen on laryngoscopy is graded I - IV as to the extent of laryngeal structures seen. This is important to note and to communicate to other health care professionals as to alert to the degree of ease or difficulty to be expected if future airway interventions are needed.

Other indicators of a difficult airway and/or mask ventilation include:

- Short, fat neck

- Small, receding chin
- Presence of a beard
- Large tongue
- Poor mouth opening, and/or neck mobility
- Facial injury with excess oral secretions
- Facial and/or neck burns
- Fractured mandible
- Laryngeal injury

G.) ROUTE OF INTUBATION

Oral intubation -This is by far the route of choice. There are few if any contraindications for the placement of an orotracheal ETT. This can be performed safely in the patient with confirmed or suspected cervical spine fracture. Combative patients or patients who won't open their mouths make this route difficult if not impossible. The use of pharmacologic agents greatly aids in the success.

Nasal intubation -The nasal route requires a spontaneously breathing patient. This can be accomplished quickly and rapidly in most cases but has contraindications such as in the presence or suspicion of basilar skull fracture and presence of facial fractures. The most common complication is epistaxis. Use in the head injured patient, with increased intracranial pressure, or combative patient with possible cervical spine injury may be detrimental to the patient. Nasal tubes also increase the occurrence of sinusitis.

Surgical airway -The use of a surgical technique, limited to cricothyroidotomy for prehospital providers, is indicated in severe facial injuries such as crush or burns that make nasal or oral intubation virtually impossible or unsafe, when oral or nasal intubation has failed to provide a definitive airway such as in severe laryngeal edema or crush injuries as well as in a failed rapid sequence intubation attempt with inability to provide oxygenation/ventilation by less invasive means. This is accomplished by locating the thyroid cartilage and sliding a finger inferiorly until the depression of the cricothyroid membrane is felt. The larynx is then held in place by the non-dominant hand and a small vertical incision is made with a # 11 scalpel blade in the membrane. The end of the scalpel handle can then be inserted and rotated in the incision to allow entry of a # 6.0 ETT. This is then secured after placement is confirmed with endtidal CO₂ and bilateral

breath sounds. A cricothyroidotomy is contraindicated in children less than 12 years old.

V. RAPID SEQUENCE INDUCTION

The trachea can be intubated by the methods already described above. Rapid sequence induction (RSI) is the use of pharmacologic agents to aid in establishing a definitive airway. Its use is common in the hospital setting. It is intended for those patients who are considered at risk of aspiration of stomach contents, the so - called “full stomach” patients; as an effort to decrease the potential occurrence of pulmonary aspiration. In the prehospital setting, any patient should be considered a full stomach and thus, at risk of aspiration. RSI has been made popular from its use in the operating room by anesthesiologists where the normal sequence of “putting a patient to sleep” is done in a more rapid fashion. But what exactly is meant by “rapid sequence induction”? Before we describe the technique some terms need to be defined:

Induction = the use of pharmacologic agents, whether it be intravenous solutions or inhaled gases, that act on the brain to quickly move from consciousness to unconsciousness; to create a plane or level of anesthesia.

Preoxygenation = the application of oxygen to the patient prior to attempting intubation.

Premedication = the administration of medications prior to the induction of anesthesia; usually chosen with a particular purpose in mind.

Cricoid Pressure = the use of gentle, continuous downward pressure on the cricoid cartilage of the larynx; intended to aid in protection from aspiration by compressing the larynx against the posteriorly located esophagus.

Neuromuscular Relaxing Agents = drugs that produce a chemical paralysis of skeletal muscle. It must always be remembered that these agents only paralyze skeletal muscle, they offer no benefit of sedation or analgesia. Also called paralytic agents, neuromuscular blockers, skeletal muscle relaxants.

A.) TECHNIQUE

Normally, in non-emergent situations, the patient is given an induction agent which rapidly produces unconsciousness and apnea. At this point, there is a period of assisted ventilation and oxygenation via bag - mask ventilation to establish the presence of a patent airway as well as to determine the ability to oxygenate. This is performed before the

administration of the neuromuscular relaxing agent (NMR). Once the presence of an airway is established and ventilation can be easily performed, the paralytic is given and intubation of the trachea follows shortly after.

The difference in the performance of RSI is the exclusion of assisted ventilation once the patient is induced. The induction agent is immediately followed by administering the paralytic agent, thus the name “rapid sequence induction”. Preoxygenation is done prior to administering any agents and cricoid pressure is applied until airway establishment has been confirmed. A sample sequence follows:

- All equipment is available and functional (laryngoscopes, ETT, suction, # 11 scalpel, pulse oximeter/end tidal CO₂ monitor, ECG and BP monitor).
- IV access is established.
- Preoxygenation with non -rebreather mask or AMBU bag - valve assisted ventilations with the application of cricoid pressure.
- Premedications, if any, are administered.
- The induction agent is administered.
- The paralytic agent is given immediately following induction.
- Laryngoscopy and intubation is performed.
- Endotracheal tube placement is confirmed (listening for bilateral equal breath sounds, absence of breath sounds over the stomach, esophageal detector, presence of end tidal CO₂, observing symmetrical chest expansion).
- Cricoid pressure is then released.
- Tube is secured.
- Patient is ventilated with additional paralysis and sedation as needed.

B) INDICATIONS

Any patient at risk of aspiration, this includes the following;

- patients with full stomach (any emergent case or trauma patient)

- pregnant patients
- patients with known reflux, hiatal hernia, or delayed gastric emptying

C) CONTRAINDICATIONS

The true contraindication to RSI is any patient who you may not be able to intubate or perform a cricothyroidotomy. Contrary to belief, the presence or suspicion of cervical spine injury (CSI) is not a contraindication of RSI.

D) CERVICAL SPINE INJURY (CSI)

The presence or suspicion of cervical spine injury is not a contraindication to performance of RSI. The technique can be performed safely if the proper patients at risk of such injury are identified and if the appropriate precautions are taken. When a patient at risk of CSI is in need of airway management and RSI is to be performed, an extra person is needed to stabilize the neck in the following fashion. Manual in-line axial stabilization (MIAS) is used to add protection against creating or causing further damage to the spinal cord. This is accomplished with the help of another provider who stabilizes the neck in a neutral position. By using both hands, the mastoid processes are grasped and the head and neck are maintained in a neutral position. To perform MIAS, three providers are needed; one for cricoid pressure, one for laryngoscopy and intubation, and another for MIAS. It is important to realize that the intention of MIAS is to provide stabilization and not traction of the cervical spine. Traction may cause distraction of any ligamentous injury and further damage an already compromised spinal cord.

E) FAILED INTUBATION

In the event that an intubation attempt has failed, a backup plan should be ready. If the patient has been induced and given paralytics then this could be a true emergency. If this scenario occurs, it is important to maintain oxygenation via bag-valve ventilation with the constant use of cricoid pressure. Another attempt at laryngoscopy and intubation may be made if mask ventilation is possible and oxygenation, as measured by pulse oximetry, is adequate. A sample algorithm follows:

- Cannot intubate
- Maintain cricoid and MIAS (if c-spine injury suspected)
- Bag-valve ventilation with 100% oxygen

- Reposition patient, attempt to optimize view, use GEB
- Reattempt laryngoscopy and intubation
- If unable to reintubate, but can bag-valve ventilate, maintain cricoid pressure and continue with bag-valve ventilation.

** If unable to bag-valve ventilate, go to surgical airway or airway adjunct (LMA, Combitube) if protocol allows.

VI. PHARMACOLOGY

INDUCTION AGENTS

SODIUM THIOPENTAL

Description: Sodium thiopental (STP) is in the barbiturate class of agents. It is ultrashort - acting, has a rapid onset with the induction of hypnosis and amnesia but not analgesia, therefore, STP has no pain relieving properties. Recovery after a bolus dose is rapid as well, although repeat dosing may lead to accumulation and prolonged duration. Cardiac depression and vasodilatation with hypotension can be severe. It is a potent respiratory depressant. STP is primarily used for the induction of anesthesia.

Indications: Induction agent, Anticonvulsant, Sedative, Intracranial pressure control

Contraindications: Presence of porphyria

Precautions: STP will cause hypotension from cardiac depression and therefore should be used with caution or in reduced doses in patients who are or are at risk of hypovolemia and/or hypotensive, hypertensive, cardiac history, elderly patients.

Dosage: Adults - 3-5mg/kg , Children/infants - 5-6mg/kg

Route: Intravenously

Supplied: As premixed syringes of 500 mg or as powder for dilution. Once reconstituted, stable for 24 hours.

ETOMIDATE

Description: Etomidate is a nonbarbiturate induction agent that lacks analgesic properties as well. It has minimal cardiovascular effects and maintains blood pressure. It too, is a potent respiratory depressant. Etomidate has been reported to decrease adrenal steroid response. Myoclonus (jerky, muscular contractions) may be seen after administration. It has a rapid onset with a short duration of action.

Indications: As induction agent, particularly useful in patient at risk of hypovolemia, with history of cardiac disease, or hypertension.

Precautions: Patients with hypertension, hypovolemia, or elderly may need decreased dosages.

Dosage: 0.1 - 0.4 mg/kg

Route: Intravenous

Supplied: Solution as 2mg/cc in 20cc vials

KETAMINE

Description: Ketamine is a phencyclidine (PCP) derivative that is rapid acting in producing a “dissociative” anesthesia in which the patient is detached from their nervous system. It has minimal cardiac depression and may increase heart rate and blood pressure by central sympathetic stimulation. Ketamine is a bronchodilator and has minimal respiratory depression with respiratory stimulation seen frequently. There is a characteristic increase in salivary secretions after administration. Unlike the other agents, ketamine has potent analgesic properties as well.

Indications: Induction agent, analgesia.

Contraindications: Patients with increased intracranial pressure

Precautions: Hypotension may be seen in patients who are relying on their sympathetic drive; use caution in patients with hypertension or cardiac disease; hallucinations and emergence reactions are common.

Dosage: 1 - 2 mg/kg

Route: Intravenous

Supplied: Solution of 10 mg/cc

PROPOFOL

Description: Propofol is a white, milky, alcohol emulsion that produces a rapid onset of anesthesia with no analgesic effects. It is rapidly metabolized and redistributed to give a short duration of action. It is a potent vasodilator and cardiac depressant with hypotension seen after administration. It is a potent respiratory depressant.

Indications: Induction agent, sedative.

Contraindications: Patients with soybean or egg allergies.

Precautions: Elderly patients, hypovolemic patients, hypertensive patients, reduced dosages are needed; may cause vascular irritation if given in small vein; emulsion supports growth of bacteria and is intended for single use.

Dosage: 2 mg/kg

Route: Intravenous

Supplied: Solution of 10mg/cc vials of 20cc.

NEUROMUSCULAR BLOCKERS

SUCCINYLCHOLINE

Description: Succinylcholine is a depolarizing muscle relaxant. It is formed by combining two acetylcholine molecules together. It attaches to the acetylcholine receptors of nerves and causes the nerve to depolarize which is seen as muscle fasciculations. It is a non-competitive agent, therefore, it remains until it is metabolized plasma cholinesterase. It is ultrashort acting lasting approximately 5 minutes. It has the fastest onset of action of any muscle relaxant.

Cardiovascular effects are minimal however, bradycardia and arrhythmias may be seen. Fasciculations can cause a transient rise in serum potassium concentration in normal patients which may be accentuated in those at risk (see below). This, as all paralyzing agents, have no sedative or analgesic properties.

Indication: Rapid skeletal muscle relaxation

Contraindications: patients with deficiencies of pseudocholinesterase; history or family history of malignant hyperthermia; penetrating eye injuries.

Precautions: Use with caution, if at all, in any patients suspected of having a difficult airway. Excessive potassium concentrations (hyperkalemia) may be seen in the following patients and should be used cautiously, if at all: spinal cord injury, burns, stroke, massive crush injuries, degenerative muscle diseases, patients exposed to temperature extremes and immobility for unknown lengths of time, renal disease. Hyperkalemia may cause ventricular fibrillation with cardiovascular collapse. The time to peak onset of such an occurrence is not known for sure but primarily seen after 7 days of injury, and the duration of such a response is not known. Generally safe to administer within 24 hours of injury. Fasciculations may cause intraocular pressure to increase and further damage open eye injuries; may increase intracranial pressure (not clinically significant).

Dosage: 1-2 mg/kg

Route: Intravenous

Supplied: Solution of 20mg/cc. Needs refrigeration, stable for 14 days at room temperature.

VECURONIUM

Description: Vecuronium is a competitive, non-depolarizing muscle relaxant. It binds to the receptors and competes for the sites with acetylcholine. It is of intermediate duration lasting approximately 30 minutes and onset is slow (3 minutes). It has minimal cardiovascular effects. Its effects may be reversed by administering an anticholinesterase which increases the amount of acetylcholine at the receptors to compete with vecuronium.

Indications: Muscle relaxation

Precautions: Use with caution, if at all, in patients with possible difficult intubation.

Dosage: Intubating - 0.1mg/kg; Maintenance - .01mg/kg

Route: Intravenous

Supplied: As a powder for reconstitution in 10 mg/10cc vials.

ROCURONIUM

Description: Rocuronium is in the same class as vecuronium however, it has a more rapid onset, (60 seconds) and a decreased duration of action. Both onset and duration are dose dependent. Generally lasts 15 - 20 minutes. Its effects are reversed as vecuronium. Cardiovascular effects are minimal, may see tachycardia. Rocuronium's favorable onset has made it the drug of choice in RSI when there is a contraindication or concern with the use of succinylcholine.

Indications: Muscle relaxation.

Precautions: Same as vecuronium.

Dosage: Intubating (RSI) - 1mg/kg; Maintenance - 0.1mg/kg

Route: Intravenous.

Supplied: Solution as 10mg/cc vials of 50mg. Stable for 30 days at room temperature.

SEDATIVES/ANALGESICS/MISCELLANEOUS MIDAZOLAM

Description: Midazolam is a benzodiazepine in the same family as diazepam. It is short acting and has a fairly rapid onset. It possesses antianxiety, amnesic, anticonvulsant,

and sedating properties for which it is commonly used for. It has no analgesic properties. It has the potential to decrease blood pressure, and is a respiratory depressant as well, which is increased if another depressant is already present (alcohol, narcotics). May be reversed by antagonist flumazenil.

Indications: Sedation

Precautions: Respiratory depression may worsen intracranial pressure. Use reduced dosages in elderly, hypovolemic, or patients with other depressants present.

Dosage: 0.5 - 1mg dosages; titrated to effect

Route: Intravenous

Supplied: Solution as 1mg/cc or 5mg/cc vials of 2 or 10 mg.

FENTANYL

Description: Fentanyl is a highly potent opioid analgesic compound in the same family as morphine. It is 100 times more potent than morphine. Fentanyl has a rapid onset and short duration of action. It is cardiovascularly stable and tends to support blood pressure. It does not release histamine like morphine. Respiratory depression is common and dose dependent. It too, is accentuated by the presence of other depressants. Fentanyl possesses some sedating properties. Its effects can be reversed with naloxone.

Indications: Analgesia/sedation, premedication prior to intubation

Precautions: Elderly, hypovolemic, or patients with other sedatives should have reduced dosages.

Dosage: 25 - 100 mcg; titrate to effect. 3-5 mcg/kg 3-5 minutes prior to intubation.

Route: Intravenous

Supplied: Solution of 50 mcg/cc in 2cc vials of 100mcg.

LIDOCAINE

Description: Lidocaine is a local anesthetic of the amide class. Its mechanism of action is by stabilizing the membranes of neuronal tissue through the inhibition of sodium passage which is needed to conduct impulses. It is also used as an antidysrhythmic agent primarily for ventricular arrhythmias.

Indications: Local anesthesia, blunting hemodynamic response to intubation, treatment of ventricular arrhythmias.

Precautions: Patients with heart block, severe hypovolemia, congestive heart failure.

Dosage: 1-2 mg/kg 3-5 minutes prior to intubation.

Route: Intravenous, endotracheal.

Supplied: 1% solution of 10 mg/cc.

VII. SUMMARY

The use of RSI is intended to allow rapid, safe airway management and protection while minimizing periods of hypoxia. Protection against aspiration of gastric contents is crucial in performing this technique. An understanding of the patients at risk of such a complication is prudent. An appreciation for the potential circumstance that a difficult intubation may exist and a plan if such an event develops,

cannot be over emphasized. This technique has been used extensively in the operating room and is gaining popularity in the emergency room as well. Despite controversy regarding the safety of RSI in the hands of prehospital providers, it has been shown that when proper training with routine assessment of skills and close medical supervision/cooperation, this can be accomplished with great success.

References

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Author Information

Robert M Pousman, DO

Assistant Professor Anesthesia and Critical Care, Department of Anesthesiology, University of Texas Health Science Center
- Houston