Rapid Sequence Intubation 2 CEUs
By: Louis Durkin MD

INTRODUCTION

A 2-hour course, covering the pharmacology and risk/benefits of various rapid sequence intubation medications. This lecture stresses the benefits of different medications for different clinical situations.

Objectives

By the end of this lecture, the participant should be able to...

1. Explain the advantages and disadvantages of RSI
2. Describe the potential side effects and complications of the most common RSI medications
3. List which patients are at greatest risk to experience complications from RSI
4. List the pharmacology of the most common RSI medications
5. Describe the phases of RSI
6. Develop a personal strategy to make RSI more likely to succeed
7. Explain the role of both sedatives and paralytics in Rapid Sequence Intubation

Case study

- You are called to the scene of a 22-year-old male involved in a motorcycle crash. He lost control at highway speed and slammed into the center divider. On your arrival you find he is unresponsive with labored respirations, and a rapid thready pulse. He is not wearing a helmet and has obvious head injuries. In assessing his airway you notice he is "clamped down" with a tight jaw and you have great difficulty opening his mouth to secure the airway.

Introduction

- Rapid sequence intubation, also known as rapid sequence induction, or medication enhanced intubation, is the use of sedating and muscle relaxing medications to aid in the intubation of conscious or struggling patients.

References

Purpose

RSI is used for a number of reasons:
1. Improve success rate (1)
2. Decrease physical trauma
3. Decrease psychologic trauma
4. Decrease aspiration
5. Improve survival

References:

Indications

- RSI may be used to enhance intubation in most circumstances as long as the relative contraindications are known and addressed.
- RSI is not a one size fits all procedure and the drugs and doses must be tailored to the individual patient and situation.

References:

Contraindications

As RSI may be considered a life saving procedure, most contraindications to RSI should be viewed as relative, since not obtaining airway control could result in death.
- Anatomic abnormalities
- Allergies to specific RSI medication
- Airway edema in the face of adequate respirations
- Facial injuries preventing use of bag valve mask
- Tracheal transection
Stages

Pre-treatment and preparation

- Induction
- Paralysis
- Intubation
- Confirmation
- Post-intubation treatment

Pre-treatment and preparation

- Preparation for intubation must begin long before you get the call.
- The equipment and medications you need should be checked at the start of every shift. The best way to ensure smooth airway control is to have all the prep work done ahead of time.
- Every component of your airway kit needs to be in working order, with a backup plan if any component fails when it is needed.

Standard equipment

- Suction and catheters
- Gloves
- Mask
- Eye protection
- Confirmation device
  - End tidal CO2 detector
  - Syringe or bulb detection device
- Oropharyngeal and nasopharyngeal airways
- Bag Valve Mask (BVM)
- Endotracheal tubes
- Laryngoscope handles and batteries
- Laryngoscope blades and spare bulbs
- Endotracheal tube stylets
- Syringes
- Magill forceps
- Locked drug box for controlled substances

Pre-treatment: Oxygen

- The most important pre-treatment medication is oxygen.
- The goal is to use 100% oxygen to washout the standard 79% nitrogen in the lungs.
- By replacing the nitrogen with oxygen, you create a "reservoir" of oxygen the patient can use after they have become apneic from the RSI medications.
- This buys you time to intubate before the patient becomes hypoxic.
**Pre-medication: Lidocaine**

- IV Lidocaine is often used prior to intubation in an attempt to blunt the spike in intracranial pressure that occurs in the head injured population.
- It is known that laryngoscopy causes pain and increases in blood pressure, heart rate and intracranial pressure in even unconscious adults.
- In the head injured, this may cause decreased blood flow to the injured brain and consequent poorer outcomes.
- Lidocaine may blunt this response a small amount and is advocated by many groups as pre-medication in the head injured patient who requires intubation.(1,2)
- Most experts agree that hypoxia and hypercarbia (CO2 retention) is worse for the patient than any other insult, and airway management should not be delayed for the administration of lidocaine if it would cause prolongation of hypoxia.
- If the patient is oxygenating well, lidocaine is a useful medication to consider as it has little detrimental effect in this population.

**References:**


**Pre-medication: lidocaine**

- IV or topical lidocaine (TL) may help prevent bronchospasm in the asthmatic patient.
- Topical lidocaine may be delivered by nebulization of 4% solution.
- This indication is still controversial, as studies have shown conflicting results. (1,2,3)

**References:**

3. Groeben, H., Silvanus, M. T., Beste, M. Combined IV lidocaine and inhaled salbutamol protect against bronchial hyperreactivity more effectively than lidocaine or salbutamol alone. Anesthesiology 1998;89:862-8
Pre-medication: Atropine

- Children may become bradycardic from both laryngeal stimulation and succinylcholine. For this reason, many use atropine to prevent this response.
- It is unclear at what age this response becomes less likely.
- Many advocate its use for any pediatric intubation, where some experts use it to treat bradycardia only if it occurs. (1,2,3)

References:


Induction/sedative agents

- The purpose of the sedative agent is to render the patient unaware of the intubation process and spare the psychological trauma and consequent physiologic response.
- There are many agents, many doses, and many distinct indications and contraindications. Be sure to check the protocols in your area for specifics.
- The most common agents used in the field are...
  - Benzodiazepines such as Midazolam and Diazepam
  - Etomidate
  - Narcotics such as Fentanyl and Morphine
  - Less common are...
    - Propofol
    - Thiopental
    - Ketamine

Midazolam (Versed)

- Midazolam is a common sedative used in the field and Emergency departments.
- It is a benzodiazepine, which causes amnesia of events, as well as sedation. This is useful in the setting of intubation.
- Down sides are hypotension at high doses, and a delay in time of onset of 60-90 seconds. But because it has a long emergency track record, it is a common sedative agent used in pre-hospital RSI.
- Typical dose varies, but is between 0.03 mg/kg and 0.1 mg/kg. (1)
References:


Etomidate (Amidate)

- Etomidate is a common induction agent with a number of beneficial properties.
  - It induces unconsciousness in 30-45 seconds.
  - It has little effect on blood pressure.
  - It decreases intracranial pressure.
  - It does, however, suppress cortisol levels, especially when used for prolonged periods.
  - This probably has no clinical effect on emergency RSI.
  - Duration is approximately 5 minutes.

Fentanyl

- Fentanyl is a high-potency, synthetic narcotic.
- It has rapid onset of 30-45 seconds, and lasts only 20-40 minutes.
- It has little effect on blood pressure, but does cause decreased respiration.
- It may also cause a rigid chest wall if pushed quickly, and it is therefore recommended to be pushed over 30-60 seconds.
- Treatment of rigid chest wall syndrome is paralytics.
- Effect on intracranial pressure (ICP) is unclear. Some studies show it blunts the ICP spike caused by laryngoscopy. Others show it causes an overall rise in the ICP of head injured patients.

Propofol (Diprivan)

- Propofol is a high potency sedative, which produces unconsciousness in 10-15 seconds. It also has the benefit of lowering intracranial pressure.
- It unfortunately causes hypotension and should be reserved for use in patients who are normovolemic and can tolerate a fluid bolus.
- Most emergency patients cannot be confirmed to meet these requirements. They are already too ill and hypotensive, or must be assumed to be hypovolemic, as in the trauma patient. It is therefore used most often in the operating room for elective surgeries.
**Thiopental**

- Thiopental is the original RSI medication.
- It produces rapid unconsciousness (10-15 sec), and reduces intracranial pressure.
- It also causes profound hypotension, and is extremely dangerous in patients with poor left ventricular function, or hypovolemia.
- In patients with compensated shock, who are normotensive, thiopental can cause extreme and even fatal hypotension. For this reason, it has limited use in the pre-hospital setting.

**Ketamine (Ketalar)**

- Ketamine is a dissociative medicine with rapid onset. (30-45 sec)
- It does not sedate, but causes a dissociative state.
- It also has sympathomimetic effects, which raises blood pressure, and causes bronchodilation. This makes it a useful agent in hypotensive or asthmatic patients.
- It also causes increased intracranial pressure, making it contraindicated in the head injured patient.
- It may also cause an emergence reaction or "bad trip", especially in adults. This is prevented by the use of Valium or Ativan.

References:

2. Bledsoe, B. E., Porter, R. S., Cherry, R. A. Paramedic Care: Principles and Practice. Brady/Prentice Hall 2000; 563-4
### Sedative Medication Table

<table>
<thead>
<tr>
<th>Sedative</th>
<th>Midazolam</th>
<th>Diazepam</th>
<th>Etomidate</th>
<th>Fentanyl</th>
<th>Propofol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose</td>
<td>0.03-0.3 mg/kg</td>
<td>0.2-0.5 mg/kg</td>
<td>0.3 mg/kg</td>
<td>3-5 mcg/kg</td>
<td>1-2 mg/kg</td>
</tr>
<tr>
<td>Induction time</td>
<td>60-180 sec</td>
<td>2-3 min</td>
<td>30-45 sec</td>
<td>30-45 sec</td>
<td>10-15 sec</td>
</tr>
<tr>
<td>Duration</td>
<td>20-30 min</td>
<td>30-40 min</td>
<td>5 min</td>
<td>30-40 min</td>
<td>3-5 min</td>
</tr>
<tr>
<td>BP effects</td>
<td>Neutral or lowers</td>
<td>Neutral or lowers</td>
<td>Neutral</td>
<td>Neutral</td>
<td>Lowers</td>
</tr>
<tr>
<td>ICP effects</td>
<td>Neutral</td>
<td>Neutral</td>
<td>Lowers</td>
<td>Unclear</td>
<td>Lowers</td>
</tr>
<tr>
<td>Advantages</td>
<td>Amnesia, good sedation</td>
<td>Amnesia</td>
<td>Fast, no effect on BP</td>
<td>Pain control</td>
<td>Fast</td>
</tr>
<tr>
<td>Disadvantages</td>
<td>Long onset, hypotension</td>
<td>Long onset, hypotension, resp depression</td>
<td>Possible seizures</td>
<td>Chest rigidity</td>
<td>Hypotension</td>
</tr>
</tbody>
</table>

### Sedative Medication Table

<table>
<thead>
<tr>
<th>Sedative</th>
<th>Ketamine</th>
<th>Thiopental</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose</td>
<td>1-2 mg/kg</td>
<td>3-5mg/kg</td>
</tr>
<tr>
<td>Induction time</td>
<td>30-45 sec</td>
<td>10-15 sec</td>
</tr>
<tr>
<td>Duration</td>
<td>10-20 min</td>
<td>5 min</td>
</tr>
<tr>
<td>BP effects</td>
<td>Raises</td>
<td>Lowers</td>
</tr>
<tr>
<td>ICP effects</td>
<td>Raises</td>
<td>Lowers</td>
</tr>
<tr>
<td>Advantages</td>
<td>Decrease bronchospasm</td>
<td>Fast, decreases ICP</td>
</tr>
<tr>
<td>Disadvantages</td>
<td>Increase ICP, emergence reaction</td>
<td>Profound hypotension</td>
</tr>
</tbody>
</table>
Paralytics

- Paralytic agents are used to relax the patient's airway and make visualization and passing the tube easier.
- It has been shown that the addition of paralytics to the RSI regimen increases success and decreases complications (1).
- Critics argue that paralyzing the patient "burns bridges", and takes a previously breathing patient and renders them apneic.
- If the rescuer is unable to intubate or ventilate, the patient dies.
- This scenario can be largely avoided with proper preparation, well thought out backup plans, and use of paralytics only in appropriate patients.

References:

Classes of Paralytics

- There are two classes of paralytics, depolarizing and non-depolarizing.
- The depolarizing agents, such as succinylcholine, cause fasciculations, and have a rapid onset.
- The non-depolarizing agents, such as Rocuronium and Rapacuronium, do not cause fasciculations, but take slightly longer than succinylcholine, and last longer (2).

Succinylcholine

- Succinylcholine is the most commonly used agent for RSI paralysis.
- It has the advantage of being the fastest onset and the fastest to wear off.
- It acts by binding to the acetylcholine receptor of skeletal muscle, causing overstimulation of the muscle (fasciculations) followed by flaccid paralysis.
- It takes 45-60 seconds to achieve paralysis and lasts about 9 minutes.
- There are a number of disadvantages to succinylcholine. Some are more theoretical than actual.
- The fasciculations may cause increased intracranial and intraocular pressure, making less than ideal in eye or head injuries.
- Hyperkalemia may occur in patients with renal failure, massive burns, crush injuries, or neurologic injuries. Note, hyperkalemia only occurs in patients who have had these injuries for several days and is not a consideration in the acutely burned or crushed patient. (1, 2, 3)
Succinylcholine can also cause bradycardia or even asystole in infants. This reaction is easily prevented with atropine.

References:

Non-depolarizing agents

- The other class of paralytics is the non-depolarizing agents (NDMB's).
- This class works by inhibiting the acetylcholine receptor on the muscle, causing paralysis.
- Unlike succinylcholine, they do not stimulate the muscle and do not cause fasciculations. For this reason, they are safe in renal failure, and will not cause hyperkalemia in burn or crush injuries.
- They also do not cause the theoretic increase in intracranial or intraocular pressure.
- The disadvantage of NDMB's is time.
- They take longer to achieve relaxation, and last much longer.
- The newest NDMB's, however are much faster and shorter acting than their predecessors. Examples include Rocuronium and Rapacuronium.
- These agents have onset times as fast as 45 seconds.
- Rapacuronium is reversible within 8-10 minutes. (1, 2, 3)

References:
Medications cont.

- Given the large number of potential medications to be used in RSI, it is no wonder there are many different protocols.
- Which combination is best in any given circumstance depends on a number of factors; the condition of the patient, pre-existing conditions, allergies, and comfort level of the paramedic with any given medication.
- After inducing and paralyzing the patient, the next step is to secure the airway.
- As the patient will have no spontaneous respirations, it is imperative that there be multiple backup options to secure the airway and assure patient survival.
- Always have a backup plan!
- Some strategies and their implementation will be covered in Airway devices and techniques.

Sedation

- After intubation, the patient will need further medication and treatment.
- No patient should ever be paralyzed without some form of sedation.
- Post intubation medications include, but are not limited to....
  - Narcotics
  - Morphine Fentanyl Demerol
  - Benzo
  - Diazepam (Valium)
  - Midazolam (Versed)
  - Lorazepam (Ativan)
  - Other
  - Propofol
  - Ketamine
- It is important to remember the hemodynamic effects of all sedatives on the patient and modify dose and choice of agent accordingly.

Summary

- Rapid Sequence Intubation is a powerful tool in airway management in the pre-hospital arena.
- If used with proper training on the proper patient, it can be life saving.
- Studies have shown much better success rate and far fewer complications when RSI is used compared to no adjuvant medication.
- Studies have also shown drastic improvement when paralytics are added.
- It must be recognized, however, that RSI takes a spontaneously breathing patient and renders them apneic.
- There are many medications to choose from, and which is best depends on local protocols, patient condition, and paramedic level of training.