Rapid Sequence Intubation

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Rapid Sequence Intubation

Simultaneous administration of drugs to facilitate endotracheal intubation in difficult, if not otherwise impossible, airway situations **AND** to attenuate adverse hemodynamic effects of intubation.

Indications for RSI

- Oxygenation failure
  - PaO_2 less than 60 on
  - FiO_2 greater than 40 %
- Ventilation failure
  - pCO_2 greater than 55 with previously normal pCO_2 or acute rise of 10 or more torr
- Need hyperventilation
- Profound shock
  - Reduces energy expenditure used during rapid breathing
- Intentional paralysis
- To protect from aspiration

Indications for RSI

- To alleviate mechanical obstruction
- To perform core rewarming

5 indicators for RSI

- Inadequate ventilation
- Inability to protect the airway
- Upper airway obstruction
- Elevated intracranial pressure
- Hypoxemia

The 10 “p”s of RSI

- Plan B
- Preoxygenation
- Preparation
- Premedication
- Put to sleep
- Position the patient
- Pressure on cricoid
- Paralysis
- Place the tube and check position
- Prevent dislodgement during transport

The XI Commandment

Thou shalt not taketh away that which thou can't give back!

Plan B: Commandment XI

- Evaluate the patient for potential difficult intubation
- Have rescue airway immediately available
- Remember: The goal is to ventilate!
  - The endotracheal tube, while the airway of choice, is not the only way to ventilate a patient.

Preoxygenation

- 100 % Non re-breathing mask
- Bag carefully to minimize air in stomach
- 2 minutes will buy you several minutes of protection from hypoxic insult

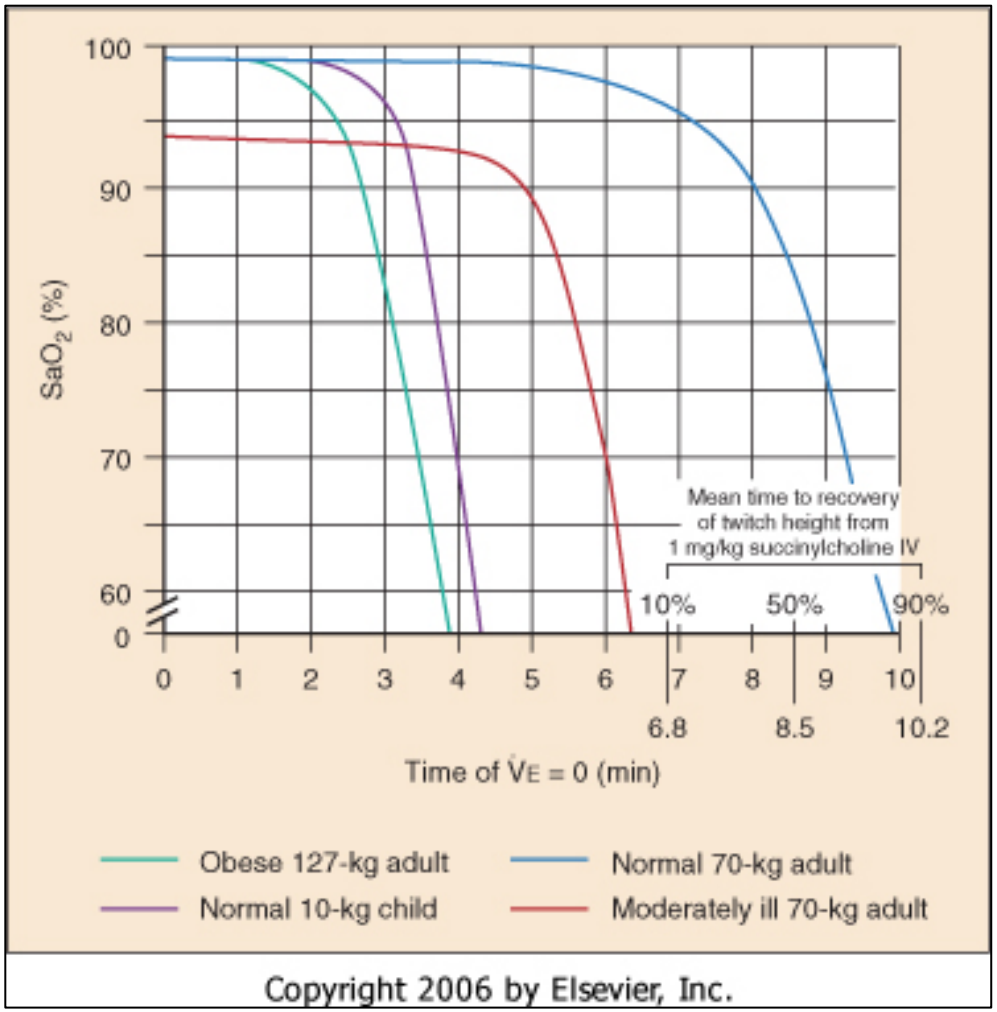


Figure 1-9 Desaturation time for apneic, fully preoxygenated patients. Children, patients with comorbidity, and obese patients desaturate much more rapidly than healthy, normal adults. The box on the lower right-hand side of the graph depicts time to recovery from succinylcholine, which in almost all cases exceeds safe apnea time. Note also the precipitous decline of oxygen saturation from 90% to 0% for all groups. (Modified from Benumof J, et al: Critical hemoglobin desaturation will occur before return to unparalyzed state following 1 mg/kg intravenous succinylcholine. Anesthesiology 87:979, 1997.)

Preparation

- Oxygen
- Suction
- IV access
- Selection of tubes
- Monitoring equipment
- Drugs
- Tape, bite block, etc.
- GOOD HELP!

Checklists for RSI, Tracheal Intubation, and Preintubation

Adult

Table 1. Recommended Equipment Checklist for Rapid Sequence Intubation (RSI) and Tracheal Intubation

Yes?	No?	Equipment
❑	❑	Cardiac monitor attached
❑	❑	Automatic BP cuff attached
❑	❑	IV infusion line established
❑	❑	Oxygen administration available
❑	❑	Pulse oximeter attached
❑	❑	Bag-mask (BM) available
❑	❑	Tracheal tubes (TT), properly sized, available
❑	❑	TT stylet available
❑	❑	Commercial device for securing TT available
❑	❑	Laryngoscope blade available
❑	❑	Laryngoscope handle with light available; confirm bulb working
❑	❑	Backup light source (another handle and blade) available
❑	❑	Suction catheter hooked to trap and wall suction or to portable suction device • Placed under pillow, left side of patient's head • Suction on; confirmed working
❑	❑	5 to 10 mL syringe to test-inflate TT balloon (then attach to pilot balloon)
❑	❑	Restraints available for patient's hands if awake
❑	❑	Container for patient's dentures if needed
❑	❑	Place towel under neck (raises neck 10 cm)
❑	❑	Esophageal detector device (aspiration technique) available
❑	❑	End-tidal CO_2 detector device (qualitative) available
❑	❑	Continuous quantitative end-tidal CO_2 monitor available
❑	❑	Medications available: adjunctive agents (lidocaine, atropine); analgesic agents (fentanyl); anesthetic agents (etomidate, propofol, methohexital, thiopental, midazolam, ketamine); paralytic agents (succinylcholine, vecuronium, pancuronium)

Premedication

- Lidocaine
- Atropine
- Consider a defasiculating agent

Lidocaine

- Most overlooked medication
- Attenuates hypertensive, tachycardic response to intubation
- Protects from increased intracranial pressure
- Suppresses cough response
- Onset 1 minute
- Maximum dose 3-4 mg/kg (recommend 1 mg/kg)

Atropine

- Dries secretions
- Can worsen tachycardia
- Very important in children to prevent reflex bradycardia

- Dose is 0.01 mg/kg with MINIMUM DOSE of 0.1 mg!

Defasiculating Agent

- Used in patients who are at risk of adverse effects of succinylcholine
- Use 1/10th the paralyzing dose of any paralytic

Put to sleep

- Valium
- Versed
- Morphine
- Fentanyl
- Thiopental
- Methohexital
- Propofol
- Ketamine
- Etomidate

Valium

- Amnestic, anxiolytic, sedative and tranquilizer
- Onset 1-2 minutes, duration 2-4 hours
- 2-10 mg for adults, 0.2-0.3 mg/kg in children
- Beware hypotension- Big problem if used with opiates
- Respiratory depression
- Has relatively long time to onset and duration of action

Versed

- More potent than Valium
- Quicker onset, shorter duration
- Dose 0.1 mg/kg
- Hypotension a problem, especially in combination with narcotics
- Do not give as rapid IV bolus

Morphine

- Better as analgesic than sedative-sedation requires high doses
- Adult dose is 5-10 mg, children .1-.2 mg/kg
- Onset 3-5 minutes, duration 3-5 hours
- Hypotension a major problem
- Onset and duration too long to make this a good choice.

Fentanyl

- Much more potent than morphine
- fast onset and offset
- Almost immediate onset, duration 45-60 minutes
- Dose is 50-100 mcg for adult , 0.1-0.2 mcg/kg for children
- Truncal rigidity if pushed rapidly
- Hypotension still a problem

Thiopental

- Gold standard by Anesthesiologists
- Causes apnea within minutes
- Dose 2-4 mg/kg for both children and adults
- Rapid onset, duration 3-5 minutes
- Decreases intracranial pressure
- Hypotension a big problem
- May cause bronchospasm

Methohexital

- Twice the potency of thiopental
- Adult dose 1.0-1.5 mg/kg
- Onset 30 seconds, duration 2-3 minutes
- Hypotension a problem, especially in hypovolemic patient
- Can cause seizure or lower seizure threshold
- Not a good choice in head trauma

Propofol (Diprivan)

- No “hang-over” effect
  - can return to work if procedure allows
- No shelf life once mixed
- Expensive
- Causes PROFOUND hypotension
- May have long duration of action
- Many feel it should not be used in ED
- Dose is 1-2mg/kg IV

Ketamine (Ketelar)

- Dissociative anesthetic
- Derivative of PCP
- Does not suppress cough response or respiratory drive
- Emergence reaction a problem
- INCREASES intracranial pressure
- Potent bronchodilator
- Increases airway secretions
- Dose is 1-2 Mg/kg IV

Etomidate (Amidate)

- Potent sedative/hypnotic
- Rapid onset (1 minute) short duration (3-5 minutes)
- Dose 0.3mg/kg IV
- Flat cardiovascular response
- Does NOT cause hypotension, histamine release, tachycardia, increased intracranial or intraocular pressure
- Excellent for trauma patients

Position the Patient

- The neck is in a neutral position
  - In adults, the neck is naturally extended, so place a towel under the occiput
  - In children, the neck is naturally flexed, so place a towel under the neck or shoulders
- Improper position is the most common cause of failed intubations!

Pressure on Cricoid

- Closes esophagus and brings trachea posteriorly
- Remove pressure if patient vomits
- BURP/ELM
  - Performed on thyroid cartilage
- Common mistakes include:
  - pressure placed before patient loses consciousness
  - not enough pressure
  - pressure released before tube placement confirmed

Paralytics

- Succinylcholine (Anectine)
- Vecuronium (Norcuron)
- Pancuronium (Pavulon)

Succinylcholine

- Depolarizing agent
- Can cause bradycardia or other dysrhythmia
- Can cause hyperkalemia, myotonia, malignant hyperthermia, prolonged neuromuscular blockade
- Avoid in renal failure, muscle trauma, burn patients, motor neuron disease, intra-abdominal sepsis
- Dose 1.0-1.5mg/kg in adults, 2 mg/kg in children

Succinylcholine

- Muscle Fasiculations
  - increased intracranial pressure
  - increased intraocular pressure
  - increased intra-abdominal pressure
- Pretreatment with a non-paralyzing dose(1/10th the paralyzing dose) of any paralytic agent may prevent fasiculations

Vecuronium

- Non depolarizing agent
- 0.1 mg/kg
- Onset 2-3 minutes, duration 30-40 minutes
- No tachycardia or increased intracranial pressure
- Excellent in head injury

Pancuronium

- Non depolarizing agent
- Onset 2-3 minutes, duration 60-90 minutes
- Indicated for maintenance of paralysis, not RSI
- Dose is 0.1 mg/kg for adults and children
- Side effects include hypertension and tachycardia
  - Avoid in heart failure or head trauma

Table 4. Sedation: Sedative and Induction Agents

Sedative	*Dosage IV Push*	*Onset*	*Duration*
Etomidate	0.2 to 0.6 mg/kg	60 seconds	3 to 5 minutes
Fentanyl	*Induction:* 2 to 10 µg/kg *Sedation (titrate):* 2 to 4 µg/kg	60 seconds	30 to 60 minutes
Ketamine	2.0 mg/kg	30 to 60 seconds	15 minutes
Midazolam	*Induction:* 0.07 to 0.3 mg/kg *Sedation (titrate):* 0.02 to 0.04 mg/kg	2 minutes	1 to 2 hours
Thiopental	3 to 5 mg/kg	20 to 40 seconds	5 to 10 minutes

Table 5. Paralyze: Neuromuscular Blocking Agents

Agent	*Dosage (Paralytic)*	*Dosage (fas pro*)*	*Onset*	*Duration*
Succinylcholine	RSI: 1 to 2 mg/kg		30 to 60 seconds	4 to 6 minutes
Rocuronium	RSI: 0.6 to 1.2 mg/kg M: 0.6 mg/kg	0.06 mg/kg	2 minutes	30 minutes
Vecuronium	RSI: 0.015 to 0.25 mg/kg M: 0.1 mg/kg	0.01 mg/kg	2.5 to 5 minutes	25 to 40 minutes
Atracurium	M: 0.4 mg/kg	0.04 mg/kg	3 to 5 minutes	20 to 35 minutes
Pancuronium	M: 0.1 mg/kg	0.01 mg/kg	3 to 5 minutes	45 to 60 minutes

RSI indicates rapid sequence intubation; fas pro, fasciculation prophylaxis/defasciculating dose; and M, maintenance dose.

Place and Check the Tube

- Listen at apices and epigastrium
- End tidal CO_2 detectors mandatory
- When in doubt, try again!

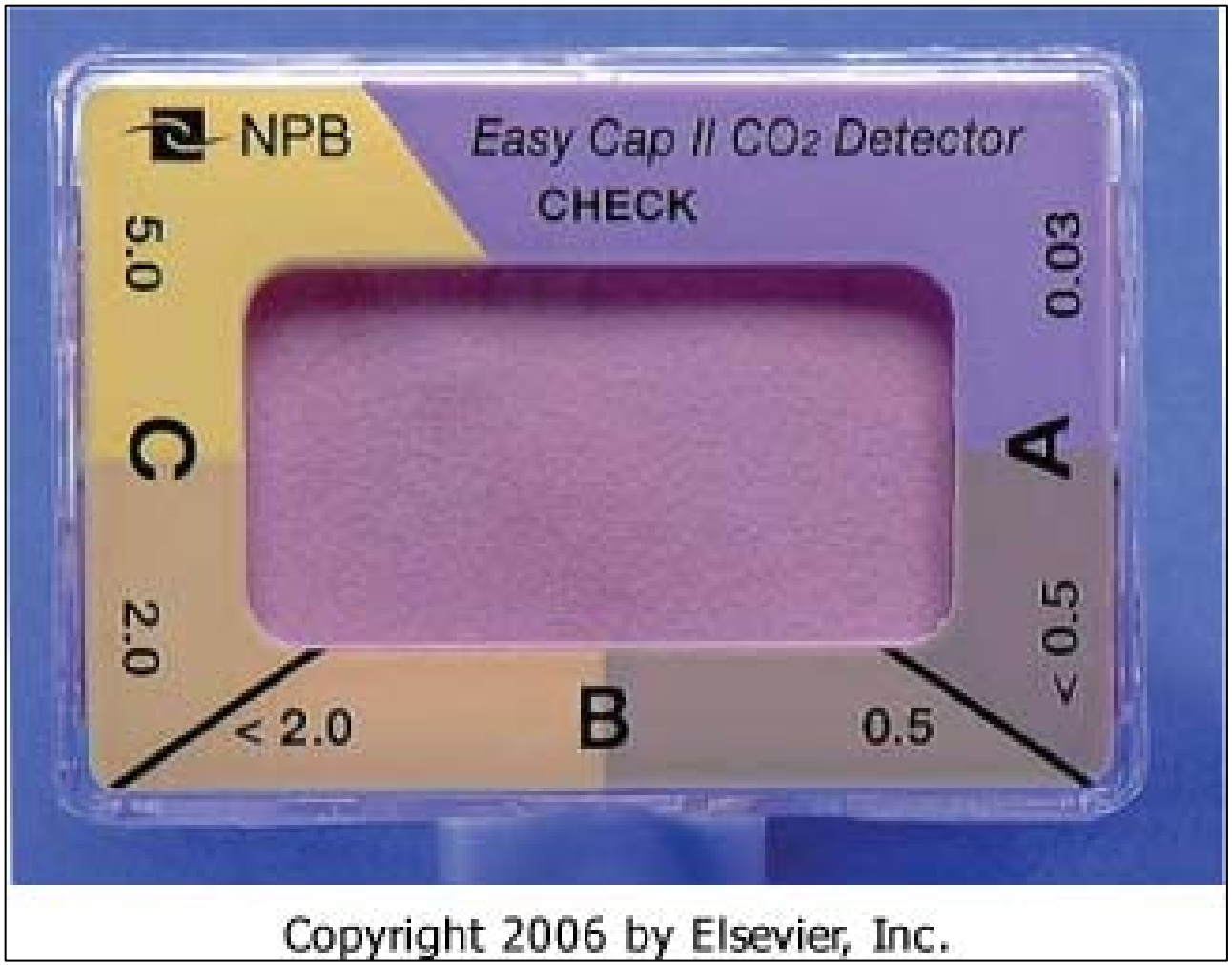


Figure 1-3 End-tidal CO2 detector before application. The indicator is purple, which indicates failure to detect CO2. This is the appearance when the esophagus is intubated.

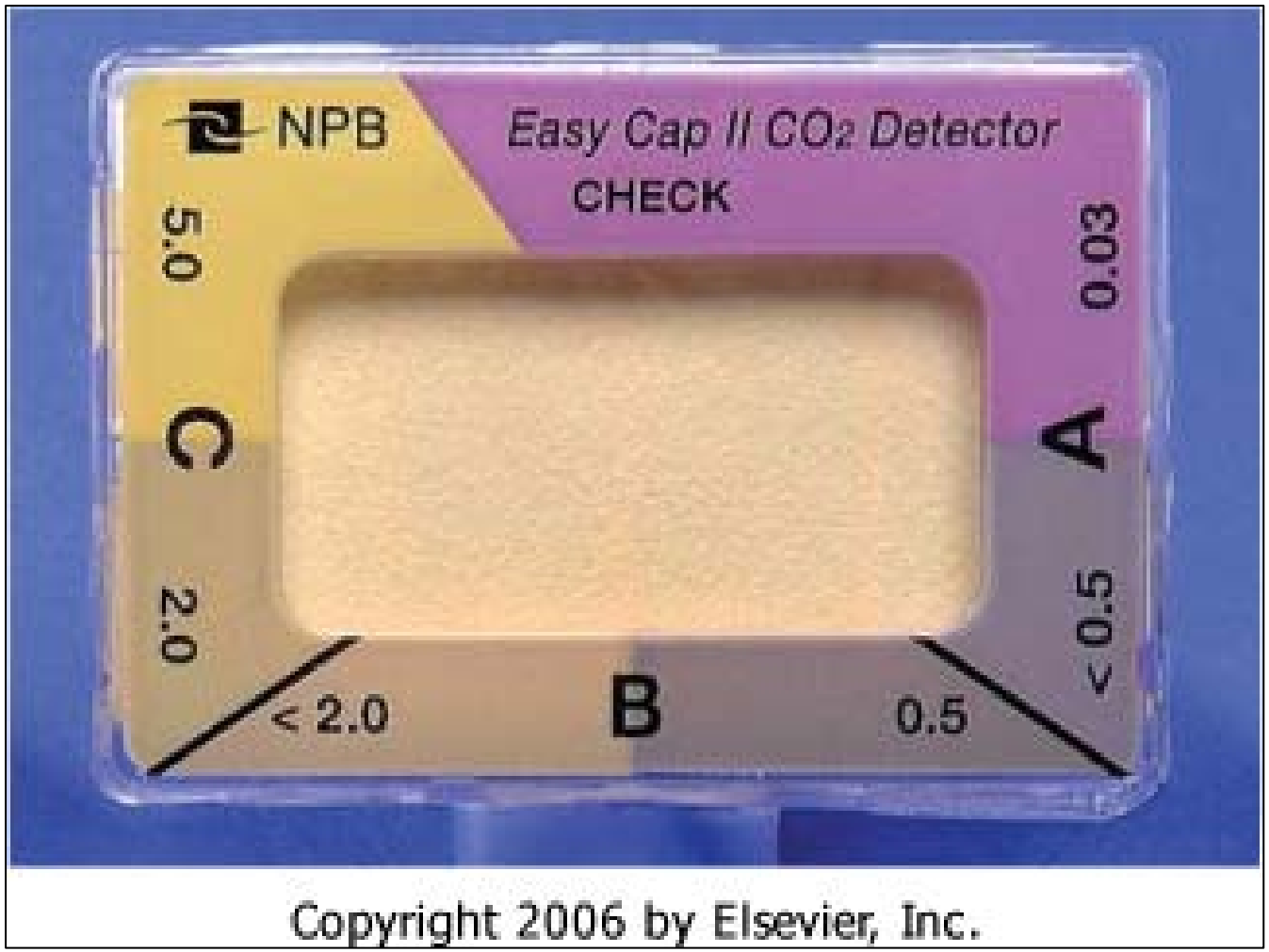


Figure 1-4 Positive detection of CO2 turns the indicator yellow, indicating tracheal placement of the endotracheal tube.

Prevent Tube Dislodgement

- Commercial tracheal tube holders
- Tape and bite block
- During transport, immobilize with cervical collar with or without backboard

Rapid Sequence Intubation Protocol

Sedative, Induction, and Neuromuscular Blocking Agents

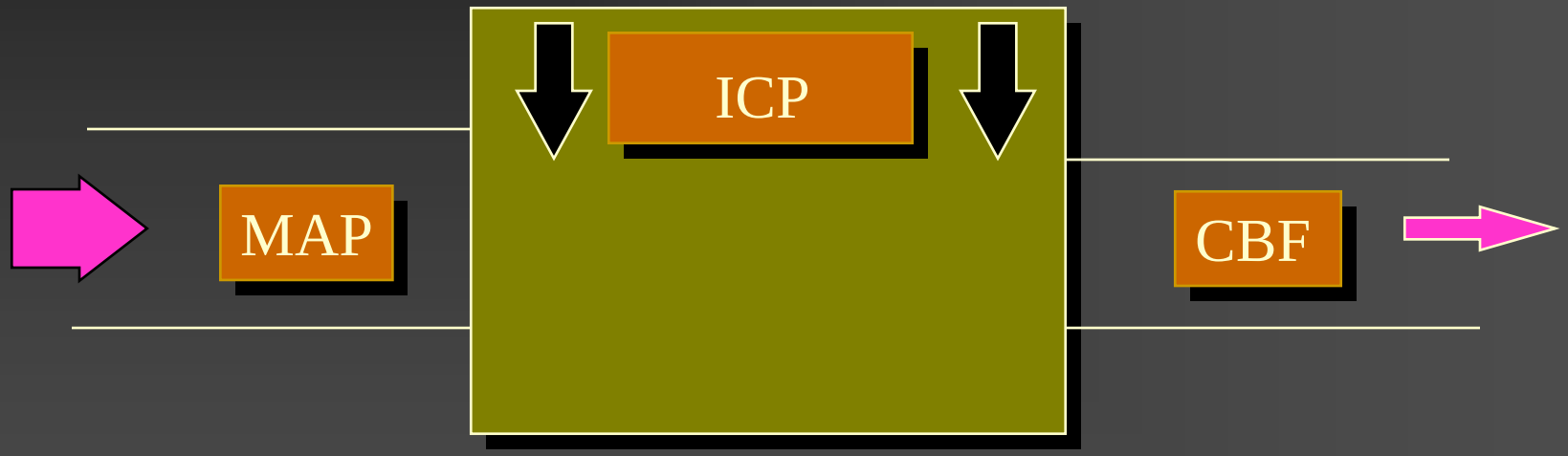
Adult

Table 3. Rapid Sequence Intubation Protocol

Steps	Details
Preoxygenate	1. Preoxygenate with 100% oxygen by mask. If ventilatory assistance is necessary, ventilate gently while applying cricoid pressure.
Premedicate	2. Premedicate as appropriate; then WAIT 3 MINUTES after drug administration. • *Fentanyl:* 2 to 3 µg/kg given at a rate of 1 to 2 µg/kg per minute IV for analgesia in awake patients • *Atropine:* 0.01 mg/kg IV push for children or adolescents (minimum dose of 0.1 mg recommended) • *Lidocaine:* 1.5 to 2.0 mg/kg IV over 30 to 60 seconds • Defasciculating agent (optional, see Table 4)
Paralyze after sedation	3. Induce anesthesia with one of these agents: thiopental, methohexital, fentanyl, ketamine, etomidate, or propofol. 4. Give succinylcholine 1.5 mg/kg IV push (use 2.0 mg/kg for infants and small children). 5. Assess for apnea, jaw relaxation, decreased resistance to bag-mask ventilations (patient sufficiently relaxed to proceed with intubation). 6. Apply cricoid pressure; WAIT 30 SECONDS.
Placement: performance	7. Perform tracheal intubation. If unable to intubate within 20 seconds, stop. Ventilate with bag-mask for 30 to 60 seconds. Use pulse oximetry as a guide. Inflate balloon cuff when TT is in place. 8. Treat bradycardia during intubation with atropine 0.5 mg IV push (smaller dose for children; see item 2).
Placement: primary confirmation	9. Perform *primary confirmation* of TT placement: • By direct visualization of TT passing through vocal cords • By chest rise/fall with each ventilation (bilateral) • By 5-point auscultation: anterior chest L and R, midaxillary line L and R, and over the epigastrium. (Listen for air entering the stomach when BM is squeezed and by tube condensation.
Placement: secondary confirmation	10. Perform *secondary confirmation* of TT placement: • Use a bulb aspiration device (esophageal detector device [EDD]). • If the EDD indicates that the TT is in the trachea, leave in place but monitor O_2 saturation, end-tidal CO_2.
Placement: prevent dislodgment	11. Secure TT with commercial TT holder (preferred). • Alternatively, secure with an adhesive tape/cloth cord technique. • In out-of-hospital setting with the prospect of patient ventilation during movement, immobilize cervical spine with cervical collar or backboard or both.

on

CBF=MAP-ICP



Putting It All Together

RSI Scenarios

- Head Trauma
- Pediatric patients
- Asthma/COPD
- Multiple Trauma
- Heart Failure
- Hyperkalemia (or suspicion of)
- All others

Case 1

- A 23 y.o. male is thrown from the bed of a pickup truck in which he was riding at 60 mph. He has a tense, rigid abdomen, bilateral femoral fractures and an unstable pelvis. His GCS is 6 and he is making gurgling sounds when he breathes. BP is 80/60, P 130 and R 40. He will not tolerate an oropharyngeal airway.

Case 1 Multiple Trauma and Head Injury

- Drugs to use
  - Oxygen
  - Lidocaine
  - Atropine (if needed)
  - Versed (carefully!)
  - Vecuronium
  - Etomidate
- Drugs to avoid
  - Narcotics
  - Barbiturates
  - Propofol
  - Succinylcholine (unless you pretreat with a defasiculating dose of another paralytic)
  - Ketamine

Case 2

- A 66 y.o. dialysis patient has missed her last three dialyses. She presents in severe respiratory distress with rales to the clavicles bilaterally. Pox on 100% NRB is 88%, BP is 240/130, P 136.

Case 2 Suspicion of Hyperkalemia/CHF

- Drugs to use
  - oxygen
  - lidocaine
  - atropine (if needed)
  - versed
  - narcotics
  - barbiturates
  - vecuronium
- Drugs to avoid
  - Succinylcholine Unless you pretreat with a defasiculating dose of another paralytic
  - pancuronium

Case 3

- A 4 y.o. asthmatic child presents in severe respiratory distress. Pox is 86 on 100% NRB, P116, R 60. There is no improvement after 15 minutes of optimal medical management.

Case 3 Pediatric Asthma

- Drugs to use
  - Oxygen
  - Lidocaine
  - Atropine (mandatory)
  - Versed
  - ketamine
  - succinylcholine
  - vecuronium
- Drugs to avoid
  - fentanyl
  - thiopental

Case 4

- A 75 y.o. man presents c/o chest pain and shortness of breath. He has rales bilaterally to the clavicles, diaphoresis, distended neck veins and 1+ pre-tibial edema. BP is 130/80, P 110 and R 40. Pox on 100 % NRB is 89%.

Case 4 CHF / Myocardial Ischemia

- Drugs to use
  - oxygen
  - lidocaine
  - atropine (if necessary)
  - versed (carefully)
  - morphine (very carefully)
  - succinylcholine
  - vecuronium
- Drugs to avoid
  - Pavulon

Commandment XI

Thou shalt not taketh away that which thou can't give back!

Rapid Sequence Intubation

James A. Vafier, M.D.