

Rapid Sequence Intubation (RSI)

OVERVIEW Rapid sequence intubation (RSI) is an airway management technique that produces inducing immediate unresponsiveness (induction agent) and muscular relaxation (neuromuscular blocking agent) and is the fastest and most effective means of controlling the emergency airway. The cessation of spontaneous ventilation involves considerable risk if the provider does not intubate or ventilate the patient in a timely manner. RSI is useful in the patient with an intact gag reflex, a “full” stomach, and a life threatening injury or illness requiring immediate airway control.

INDICATIONS FOR INTUBATION AND MECHANICAL VENTILATION

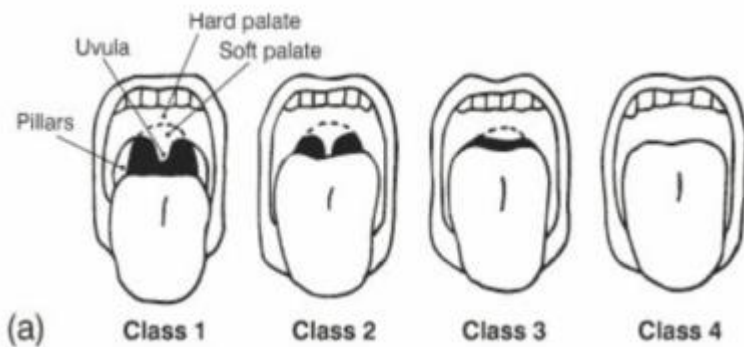
1. Airway protection and patency
2. Respiratory failure (hypercapnic or hypoxic), increased FRC, decrease WOB, secretion management/ pulmonary toilet, to facilitate bronchoscopy
3. Minimize oxygen consumption and optimize oxygen delivery (e.g. sepsis)
4. Unresponsive to pain, terminate seizure, prevent secondary brain injury
5. Temperature control (e.g. serotonin syndrome)
6. Humanitarian reasons (e.g. procedures) and for safety during transport (e.g. psychosis)

Pro	Con
Lack of airway protection despite patency	
Hypoxia	Anesthetist available
Hypoventilation	Anatomically or pathologically difficult airway
Neuroprotection (i.e. target PaCO ₂ 35-40 mmHg)	Pediatric cases (especially <5 years of age)
Impending obstruction (i.e. airway burn, penetrating neck injury)	Hostile environment
Prolonged transfer	Poorly functioning / staffed team
Combativeness	Lack of requisite skills among team
Humanitarian (i.e. requiring multiple interventions)	Emergency surgical airway not possible (e.g. neck trauma, tumor)
Cervical spine injury (diaphragmatic paralysis)	

FACTORS THAT MAKE EMERGENCY INTUBATION DIFFICULT (*Airwaycam.com; Richard Levitan*)

RSI useful if the following present:

- Dynamically deteriorating clinical situation
- Uncooperative patient
- Respiratory and ventilatory compromise
- Impaired oxygenation
- Full stomach (risk of vomiting, aspiration)
- Short “safe apnea” times
- Secretions, blood, vomitus, and distorted anatomy



M	Mask seal
O	Obesity/Obstruction
A	Aged (> 55 years)
N	No teeth
S	Stiff lungs

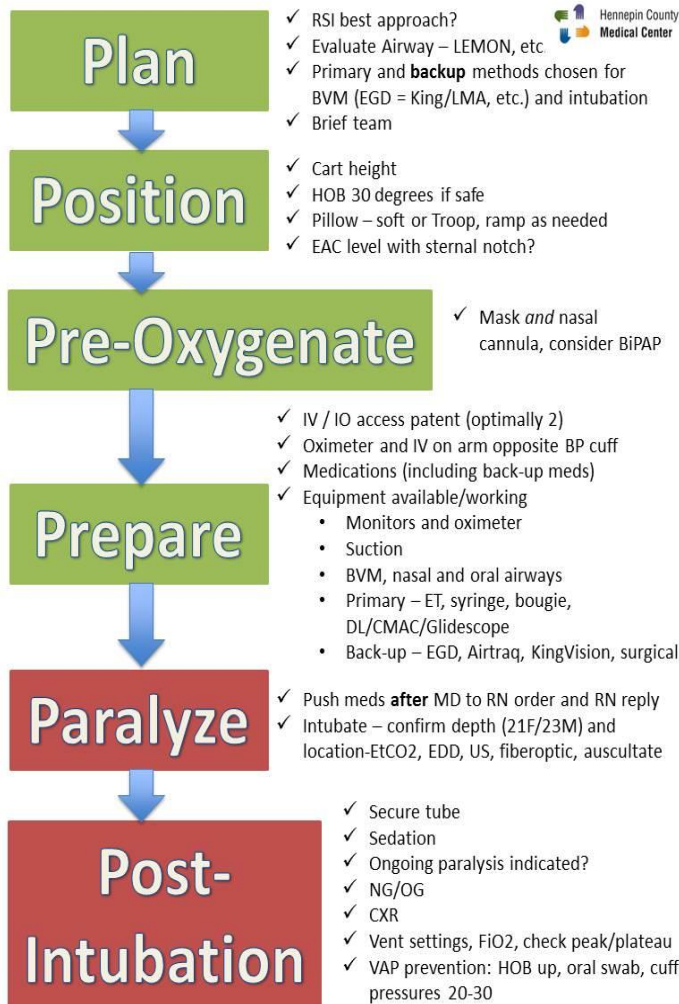
Medscape

Source: Jrl Emerg Med © 2014 Elsevier, Inc

L	Look externally (gestalt)
E	Evaluate 3-3-2 rule
M	Mallampati scale
O	Obstruction/Obesity
N	Neck mobility

Medscape

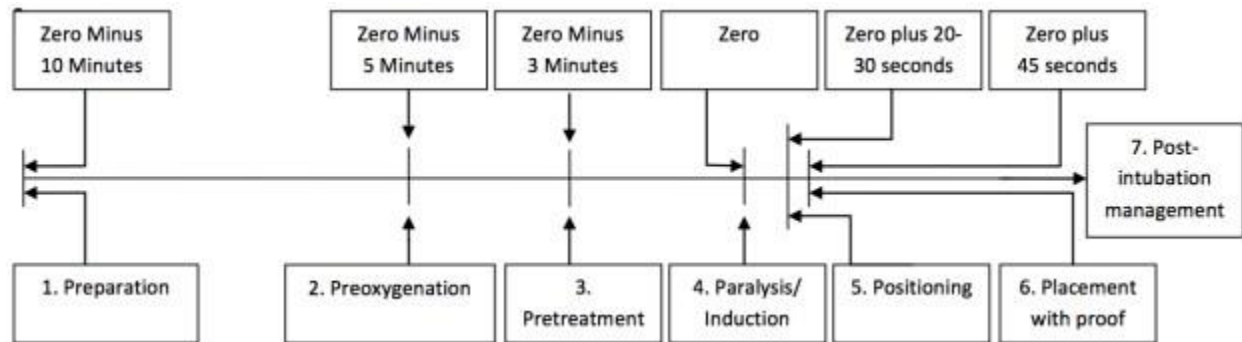
Source: Jrl Emerg Med © 2014 Elsevier, Inc



RSI PROCESS ~ 9 (or 10) Ps

Minimize instrumentation and suctioning prior to intubation to avoid stimulation of the gag reflex.

1. Plan
2. Preparation (drugs, equipment, people, place)
3. Protect the cervical spine
4. Positioning
5. Preoxygenation
6. Pretreatment (i.e. atropine, fentanyl and lidocaine)
7. Paralysis and Induction
8. Placement with proof
9. Postintubation management
10. Pressure on cricoid (optional)



TEAM ROLES DURING RSI

- Minimum of 3: Airway Proceduralist, Airway Assistant, Drug administrator
- Preparation requires control over: Self, Patient, Others, Environment
- Maintain a 'sterile cockpit environment' when communicating the airway plan to the team, ideally through use of a 'call and response' checklist— otherwise one of these two mnemonics will help: *SOAPME / O2 MARBLES*
- **Suction:** at least one working suction, place it between mattress and bed
- **Oxygen:** NRBM and BVM attached to O2 15LPM, with nasal prongs for apneic oxygenation
- **Airways:** 7.5 ETT (most adults), 7.0 (smaller females), 8.0 (larger males). Test balloon
 Stylet: lubricated, placed inside ETT for rigidity, bent 30 degrees at proximal end of cuff
 Blade: Videoscope should be primary, followed by Mac 3 or 4, Miller 3 or 4 (adults)
 Handle: Attach blade and make sure light source works
 Backups: Surgical cric kit, alternative video laryngoscope, LMA and bougie at bedside
- **Pre-oxygenate:** 15 LPM NRBM
- **Monitoring equipment / Medications:** Cardiac monitor, pulse ox, BP cuff opposite arm with IV, Medications drawn up and ready to be given
- **End Tidal CO2**

O2 MARBLES is an alternative for the equipment and planning:

- Oxygen
- Masks (NP, NRB, BVM); monitoring
- Airway adjuncts (e.g. OPA, NPA, LMA); Ask for help and difficult airway trolley
- RSI drugs; Resus drugs
- BVM; Bougie
- Laryngoscopes; LMA
- ETTs; ETCO2
- Suction; State Plan

DRUG DOSAGES FOR RSI

Doses shown are for IV / IO administration. IBW = ideal body weight, TBW = total body weight
Doses may need to be adjusted in the hypotensive patient.

Premedication Agents

- Atropine 20 mcg/kg IV: prevent bradycardia in children
- Lidocaine 1.5mg/kg IV: sympatholytic, neuroprotection in head injury; decrease airway reactivity in asthma
- Fentanyl 2-3 mcg/kg IV: sympatholytic, neuroprotection in head injury and vascular emergencies (e.g. myocardial ischemia, aortic dissection, subarachnoid hemorrhage)
- Defasciculating dose of a non-depolarizing neuromuscular blocker (ie. rocuronium 0.1 mg/kg IV or vecuronium 0.01 mg/kg IV): prevents fasciculations from succinylcholine (e.g. TBI)

Induction Agents

The ideal induction agent smoothly and quickly render the patient unconscious, unresponsive and amnestic in one arm/heart/brain circulation time, provide analgesia, maintain stable cerebral perfusion pressure and cardiovascular hemodynamics, be immediately reversible and have few, if any, side effects.

- Ketamine
 - Dose: 1.5 mg/kg IV (4mg/kg IM)
 - Onset: 60-90 sec
 - Duration: 10-20 min
 - Use: any RSI, especially if hemodynamically unstable (does not increase ICP despite traditional dogma) or if reactive airways disease (causes bronchodilation)
 - Drawbacks: increased secretions, caution in cardiovascular disease (hypertension, tachycardia), laryngospasm (rare), raised intra-ocular pressure
- Etomidate 0.3-0.4 mg/kg TBW
 - Onset: 10-15 seconds
 - Use: suitable for most situations including haemodynamically unstable, other than sepsis or seizures
 - Drawbacks: adrenal suppression, myoclonus, pain on injection,
- Fentanyl
 - Dose IV 2-10 mcg/kg TBW
 - Onset: <60 seconds (maximal at ~5 min)
 - Duration: dose dependent (30 minutes for 1-2 mcg/kg, 6h for 100 mcg/kg)
 - Use: low dose as a sympatholytic premedication (e.g. TBI, SAH, vascular emergencies); may used in modified RSI approach in low doses or titrated to effect in cardiogenic shock and other hemodynamically unstable conditions
 - Drawbacks: respiratory depression, apnea, hypotension, slow onset, nausea and vomiting, muscular rigidity in high induction doses, bradycardia, tissue saturation at high doses
- Midazolam

- Dose: 0.3mg/kg IV TBW
- Onset: 60-90 sec
- Duration: 15-30 min
- Use: not usually recommended for RSI, some practitioners use low doses of midazolam and fentanyl for RSI of shocked patients
- Drawbacks: respiratory depression, apnea, hypotension, paradoxical agitation, slow onset, variable response
- Propofol
 - 1-2.5 mg/kg IBW + (0.4 x TBW) or 1.5 mg/kg x TBW
 - Onset: 15-45 seconds
 - Duration: 5 – 10 minutes
 - Use: Hemodynamically stable patients, reactive airways disease, status epilepticus
 - Drawbacks: hypotension, myocardial depression, reduced cerebral perfusion, pain on injection, variable response, very short acting

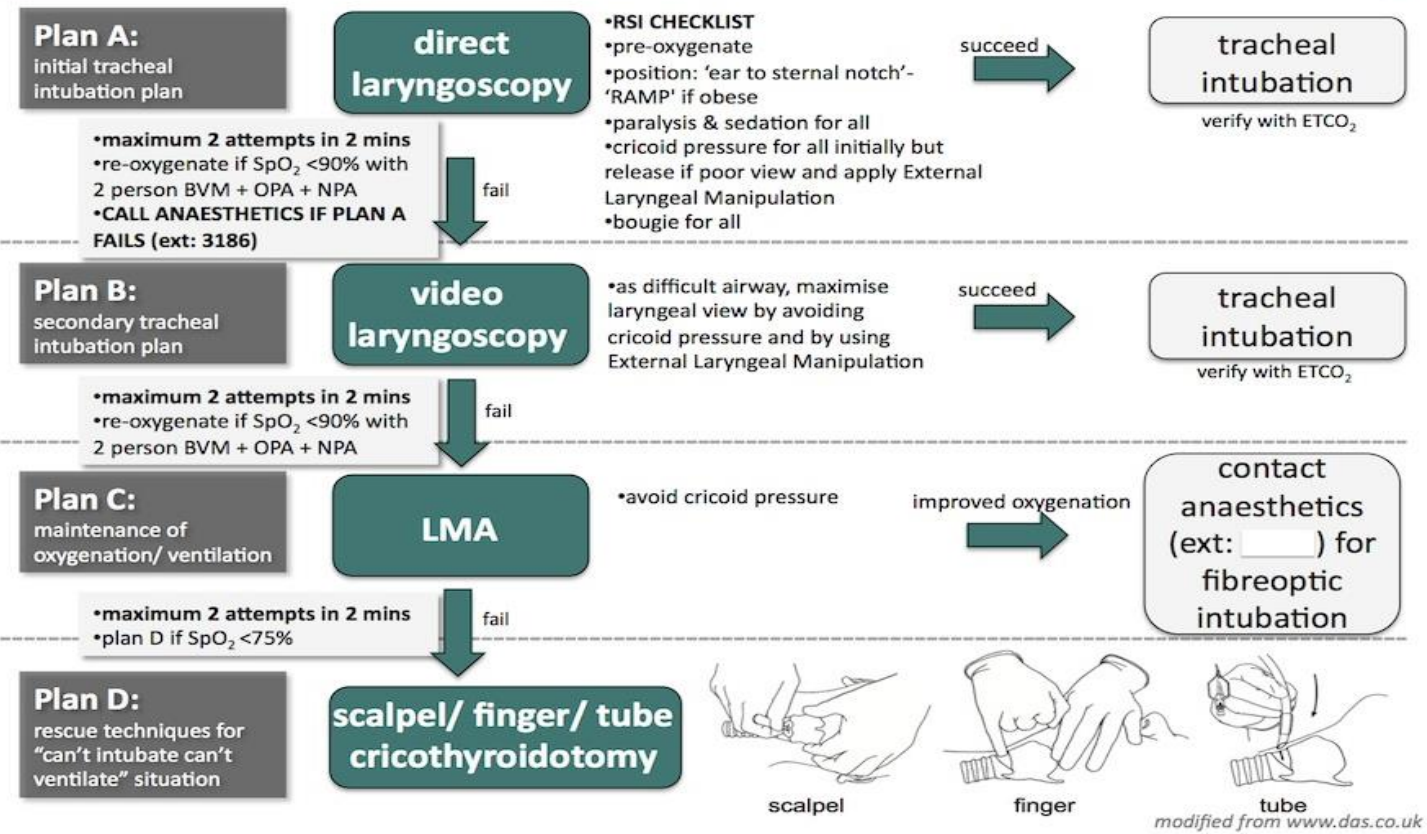
Neuromuscular Blockers

- Succinylcholine
 - Dose: 1.5 mg/kg IV (2 mg/kg IV if myasthenia gravis), 4 mg/kg IM (in extremis)
 - Onset: 45-60 seconds
 - Duration: 6-10 minutes
 - Use: ideal if need to extubate rapidly following an elective procedure or to assess neurology in an intubated patient
 - Drawbacks: numerous contra-indications (hyperkalemia, malignant hyperthermia, >5d after burns/ crush injury/ neuromuscular disorder), bradycardia (especially after repeat doses), hyperkalemia, fasciculations, elevated intra-ocular pressure, will not wear off fast enough to prevent harm in CICV situations
- Rocuronium
 - Dose: 1.2 mg/kg IV IBW
 - Onset: 60 seconds
 - Use: can be used for any RSI unless contra-indication or require rapid recovery for extubation after elective procedure or neurological assessment; ensures persistent ideal conditions in CICV situation (i.e. immobile patient for cricothyroidotomy) – can be reversed by sugammadex
 - Drawbacks: allergy (Rare)
- Vecuronium
 - Dose: 0.15 mg/kg IV (may precede by a 0.01 mg/kg IV priming dose 3 minutes earlier)
 - Onset: 120-180 seconds
 - Duration: 45-60 minutes
 - Use: RSI, can be reversed by sugammadex
 - Drawbacks: allergy (rare), slow onset, long duration

TABLE 1: IV INDUCTION AND NEUROMUSCULAR BLOCKING DRUGS FOR RSI/DSI

AGENT	STANDARD DOSE (MG/KG)	DOSE IF HEMODYNAMIC COMPROMISE	COMMENTS
Etomidate	0.2-0.3	0.1-0.2	Rapid onset, short duration. Few hemodynamic effects. Preferred for hypotensive patients with head injury or coronary artery disease.
Ketamine	1.0-2.0	No difference	Longer duration. Sympathetic stimulation, bronchodilation, dreams, salivation. Preferred for patients with asthma.
Propofol	2.0-2.5 mg/kg given 40 mg every 10 seconds	No difference	Slow injection preferred over rapid bolus administration. Rapid bolus may result in cardiorespiratory depression. Titrate dose to response. Maintenance doses by infusion are preferred: 0.3-3 mg/kg/hr for prolonged sedation. Avoid in patients with hypovolemia.
Fentanyl and midazolam	Fentanyl 1.0-4.0 mcg/kg for pain; midazolam 5.0-10.0 mg for sedation	Reduce by 50% if hemodynamically compromised	Can cause respiratory depression during initial administration. Excellent for prolonged sedation and pain control, but monitor vital signs often.
Succinylcholine	0.6-1.5	No difference	Short-acting. Many contraindications and adverse effects. Clinical duration 4-6 minutes.
Rocuronium	0.6-1.5	No difference	Onset time equal to succinylcholine. Clinical duration 30-60 minutes.
Vecuronium	0.08-0.10	No difference	Onset time 2-3 minutes. Clinical duration 25-40 minutes.

DEFAULT STRATEGY FOR FAILED RSI IN ADULTS



Excellent Links and References

- Website: Life in the Fast Lane: WWW.LITFL.com
 - Amazing resource for critical care and emergency medicine clinicians
 - Check out: Pediatric Rapid Sequence Intubation, Preoxygenation, Intubation, Hypotension and Shock, Difficult Airway Algorithms, Direct Laryngoscopy, Cricoid Pressure
- Webinar: http://www.ashpmedia.org/connect/table/webinars_full.html - RSI
- Webinar: EM Lyceum
 - Rapid Sequence Intubation, Episode 1 and RSI Episode 2: Induction, “Answers”
- Websites: Airwayworld.com and Airwaycam.com
 - Nothing better on the internet for airway resources
- Website: ALIEM (Academic Life in Emergency Medicine)
 - Paucis Verbis card: Rapid Sequence Intubation card
- Course: Difficult Airway Course
 - Expensive but good, covers basics as well as “trick shots”, has prehospital, hospital and anesthesia-specific courses
 - Has airway cards for purchase – very helpful
- Journal articles
 - Bernhard M et al. The First Shot Is Often the Best Shot: First-Pass Intubation Success in Emergency Airway Management. *Anesth Analg.* 2015; 121(5):1389-93.
 - El-Orbany M, Connolly LA. Rapid sequence induction and intubation: current controversy. *Anesth Analg.* 2010 May 1;110(5):1318-25. doi: 10.1213/ANE.0b013e3181d5ae47. Epub 2010 Mar 17
 - Stept WJ, Safar P. Rapid induction-intubation for prevention of gastric-content aspiration. *Anesth Analg.* 1970 Jul-Aug;49(4):633-6.
 - Stewart JC, Bhananker S, Ramaiah R. Rapid-sequence intubation and cricoid pressure. *Int J Crit Illn Inj Sci [serial online]* 2014 [cited 2014 Apr 19];4:42-9.