Emergent Intubation in Children

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Introduction

Critically ill children may require emergent intubations for a number of indications including:

- Cardiopulmonary arrest
- Loss of protective airway reflexes
- Respiratory failure not responsive or not suitable for non-invasive ventilatory support
- Anticipated deterioration of disease process
- Progressive haemodynamic instability

Emergency intubations are more difficult to perform than elective planned intubations because:

- Patients are usually not fasted, with an inherent risk of aspiration
- Rapid clinical deterioration may compromise on preparation time and response to pre-medications
- Patients with underlying disease physiology may be more susceptible to the adverse effects of the intubation process

The potential complications related to the intubation process include:

- **Hypoxia:** This occurs from the underlying disease process, or from prolonged laryngoscopy. Sustained periods of hypoxia can result in ischaemic brain injury, the most significant complication of endotracheal intubation.

- **Bradycardia:** Profound bradycardia can occur during the intubation process either secondary to hypoxia, or as a vagal response to laryngeal manipulation. The use of atropine as a pre-medication may help prevent vagal-mediated bradycardia.

- **Increased intracranial pressure (ICP):** An increase in cerebral arterial pressure occurs during laryngoscopy, resulting in an increase in ICP. This is of particular importance in patients who already have elevated pressures. Adequate sedation and paralysis help attenuate this response.

- **Mechanical trauma:** Inappropriate laryngoscopy techniques can result in injury to teeth, lips, tongue and oral mucosa. The endotracheal tube can also injure the vocal cords, resulting in vocal cord edema or paralysis.

- **Gastric distension and aspiration:** Bag valve mask ventilation can cause gastric distension, which may compromise lung expansion, and increase risk of aspiration. Direct laryngoscopy may also stimulate the gag reflex in inadequately sedated patients.

- **Laryngopasm:** Laryngospasm is a reflex closure of the glottis (vocal cords) to an abnormal stimulus. Risk factors include laryngoscopy, inadequate sedation/anaesthesia, multiple attempts at laryngeal manipulations, secretions and suctioning of the airway. If complete glottic closure occurs (converting the patient to an “unable to mask ventilate” situation), profound hypoxia can ensue, potentially leading to ischaemic injury and/or cardiac arrest. The use of adequate sedation/anaesthesia and paralysis pre-procedure, as well as competent direct laryngoscopy experience ameliorates this risk.

- **Adverse effects related to pre-medications** (see later section)

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Rapid sequence induction

Rapid sequence induction (RSI) is a sequential process of preparation, pre-oxygenation, pre-medication (with paralysis and sedation) to facilitate a safe, emergent tracheal intubation. Manipulation of the airway results in predictable physiological responses which may have adverse effects on the patient. RSI has been demonstrated to be superior (in both safety and success) to intubation without sedation and paralysis in patients with varying levels of consciousness, active airway reflexes and/or a full stomach.

Indications for RSI

In the intensive care and emergency setting, RSI is the preferred method for emergently intubating ALL patients with intact airway reflexes with a presumed full stomach. RSI is not required for patients already in cardiopulmonary arrest.

Contraindications to RSI include:

- Anticipated difficult airway (Difficult to mask ventilate, difficult to intubate or abnormal airway anatomy)
    - Eg. Epiglottitis; severe ALTB; orofacial deformities such as facial fractures or micrognathia; airway injuries

These patients require input and assistance from paediatric anaesthetists and ENT surgeons.

Assessment

This includes taking a history (including drug allergy, previous anaesthetic history, last meal, past medical history) and a rapid assessment looking for:

- **Anatomical considerations** associated with difficult airway management (small chin, macroglossia, poor mouth opening, decreased neck mobility, severe obesity, large tonsils)
- **Congenital abnormalities** associated with difficult airway (eg. Pierre Robin Sequence, Treacher-Collins)
- **Evidence of airway obstruction** (eg. Epiglottitis, croup, history of tracheal stenosis/subglottic stenosis, tongue haemangioma)
- **History of previous difficult intubation**

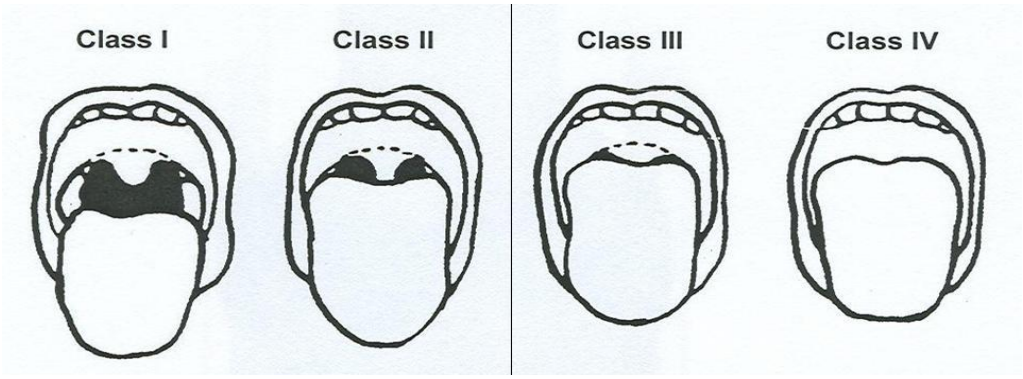
Some clinicians also recommend using other assessment tools such as the Mallampati score (see figure 1).

Mallampati Class

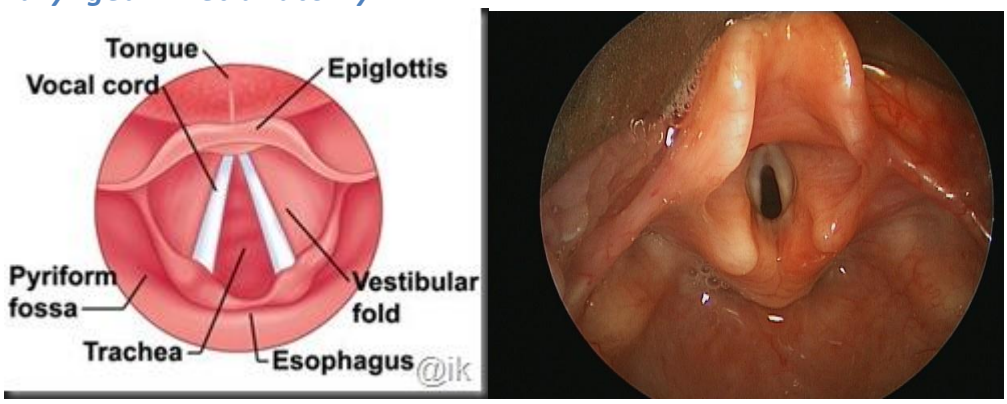
The Mallampati classification is used to assess the tongue size in relation to the size of the oropharynx, and is best assessed with the patient seated with their head in a neutral position; mouth open wide and tongue protruding without phonation (see Fig. 1). A class 3 or 4 may be associated with a difficult laryngoscopy view.

Class I	Entire posterior pharynx visualised
Class II	partial visualisation of posterior pharynx, tip of uvula not seen
Class III	Only soft palate seen
Class IV	No posterior structures seen

Fig. 1 Mallampati Class



Laryngeal inlet anatomy

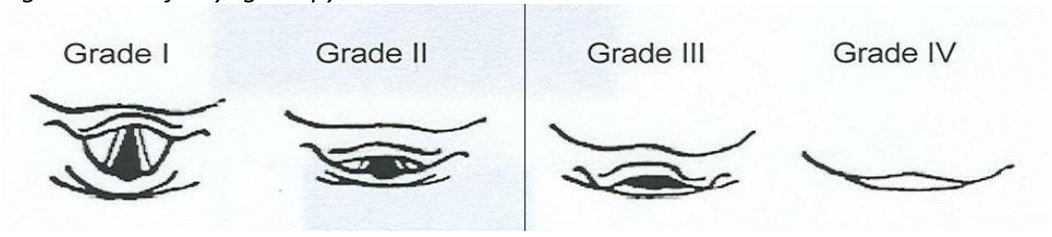


Grade of laryngoscopy (Modified Cormack-Lehane scale)

The extent of visualization of the glottal opening under direct laryngoscopy is categorized by a standardized grading system (Cormack-Lehane scale) and is useful for objective description of the view for future airway management (see Fig 2).

Grade 1	Full view of vocal cords
Grade 2a	Partial view of vocal cords
Grade 2b	only aryteniods and epiglottis seen
Grade 3	Epiglottis seen only
Grade 4	Neither epiglottis nor glottis visualised.

Fig. 2 Grade of laryngoscopy



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Intubation Plan

Prior to intubation, an intubation plan should be developed, and should include:

1. Reason for intubation
2. Choice of RSI medications based on patient's history and disease process
3. Potential complications unique to the patient and how to overcome these complications
4. Contingency plan in the event of failed intubation
5. Role assignment to each healthcare provider

Medications

Medications used for RSI can be broadly divided into sedatives/induction agents, analgesics, and paralytic agents.

Factors that need to be considered when choosing sedative/paralytic agents include:

- Presence of haemodynamic instability
- Neurological abnormalities (eg. Raised intracranial pressure, seizures)
- Asthma/ bronchial hyper-reactivity
- Chronic myopathy or denervating neuromuscular disease
- History of malignant hyperthermia
- Sepsis
- Pre-existing hyperkalaemia
- 48-72 hours after burns or crush injury

Induction agents

Drug	Dose	Onset of Action	Mechanism of action	Adverse Effects
Etomidate	0.3mg/kg IV	Fast onset of action; ultra-short acting sedative and induction agent.	Provides reliable sedation and induction without significant haemodynamic compromise. Decreases ICP and cerebral metabolic rate**, potentially useful in patients with raised intracranial pressure** or haemodynamic instability WITHOUT pre-existing adrenocortical insufficiency.	**Contraindicated in patients with septic shock/sepsis**; causes adrenocortical insufficiency. Myoclonus may be seen.
Ketamine	1-2 mg/kg IV	Fast onset of action	Provides sedation, analgesia and amnesia while preserving airway reflexes. Causes catecholamine release, resulting in augmentation of heart rate and blood pressure; and brochodilatation. **Useful in patients who are hypotensive, or are in bronchospasm.**	**Potent sialogogue**. Theoretical risk of raised intra-cranial pressures, **use with caution in patients at risk of raised intracranial pressures.**
Thiopental	2-5 mg/kg IV	Rapid onset of action	Provides reliable sedation and induction. Reduces cerebral oxygen consumption and blood flow, with anti-convulsive properties. **Potentially useful for patients with neurological disease who are haemodynamically stable**	Causes vasodilation and myocardial depression. **Not suitable for haemodynamically unstable patients**. Also results in histamine release, which can cause vasodilation and **broncho-constriction**.

Propofol	2.5-3.5mg/kg IV	Rapid onset, short duration of action	Lipid soluble nonbarbiturate sedative-hypnotic that produces general anaesthesia.	Contains egg and soybean oil, **contraindicated in patients with egg or soy allergies.** Causes vasodilation and myocardial depression (more pronounced than thiopental), **not suitable for patients with haemodynamic instability.** May cause burning at injection site.
Midazolam	0.1mg/kg IV	Fast onset, short duration of action	**Potent amnesic, sedative and anti-convulsant properties**. Time to clinical effect slower than other induction agents.	**Causes respiratory depression** and patients may develop apnoea before receiving paralysis. Causes dose-dependent systemic vasodilatation and myocardial depression, **use with caution in patients with haemodynamic compromise**.

No single sedative agent exists for every RSI scenario.

Analgesics and Paralytic agents

These drugs are discussed in more details in the CICU Handbook chapter on "Pain and Sedation".

Specific scenarios

We suggest the following RSI agents based on our unit preferences:

Scenario	Option	Induction/ sedative	Analgesia	Paralytic	Adjuncts
Hypotension	1	Ketamine		Succinylcholine or rocuronium	Atropine in < 1 year
	2	Midazolam	Morphine or fentanyl	Succinylcholine or rocuronium	Fluid resuscitation if needed
Hypotension with head injury	1	Etomidate +/- opioid for analgesia		Rocuronium	
	2	Midazolam	Morphine or fentanyl	Rocuronium	Fluid resuscitation if needed
Status asthmaticus	1	ketamine		Succinylcholine or rocuronium	Atropine in < 1 year
	2	Midazolam	Fentanyl	Succinylcholine or rocuronium	
Status epilepticus	1	Midazolam	Morphine	Succinylcholine or rocuronium	
	2	Thiopentone	Morphine	Succinylcholine or rocuronium	Fluid resuscitation if needed
Neuromuscular disease or myopathy	1	Midazolam	Morphine	Rocuronium	

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Intubation Pathway

Preparation	Prepare personnel (assign roles and responsibilities); prepare drugs; equipment and monitoring; check presence of venous access <u>Roles:</u> • Principal procedurist (who will BVM and intubate) • Person assisting with airway equipment • suctioning • administer drugs • monitor vital parameters • provide cricoid pressure • auscultation and check chest rise
Pre-oxygenation	Pre-oxygenate with 100% oxygen (allow spontaneous ventilation as far as possible) for at least 4 minutes to fill patient's FRC with 100% oxygen. • This provides an oxygen reserve in the patient's lungs during the apnoeic period prior to insertion of the ETT and prolongs the period before desaturation occurs. • This may not prevent desaturation in patients with lung disease as their FRC is already compromised.
Drugs	Administer appropriate doses of RSI agents. Consider drawing extra doses in case top-ups are required. Avoid ventilating the patient (BVM) after RSI to decrease the risk of gastric insufflation and vomiting.
Cricoid pressure	Cricoid pressure may be required, but is not routine. Release cricoid pressure after the ETT is securely in place
Intubation	Please refer to endotracheal intubation checklist
Confirmation	• Chest rise • Auscultation • Misting of the ETT • ET-CO_2 colorimetery • ET-capnometer waveforms • CXR
Maintenance sedation/paralysis	Consider infusions based on individualised patient requirements
Re-assess, monitor and trouble shoot	Causes of oxygenation failure post intubation DOPE algorithm: Dislodgement, Obstruction, Pneumothorax, Equipment

References

1. Preoxygenation and prevention of desaturation during emergency airway management. Weingart SD, Levitan RM. Ann Emerg Med 2012; 59(3): 165-175
2. Difficult airway algorithm and Endotracheal intubation. Appendices. Fundamentals of Pediatric Critical Care Support.