Emergency Department Rapid Sequence Intubation

1. Proposed Algorithm

   Pre-Medication
   • None

   Induction Agent
   • 1st line: Etomidate 0.3 mg/kg IV
   • 2nd line: Ketamine 1-2 mg/kg IV (1st line in reactive airway disease, hemodynamic instability)

   Paralytic
   • 1st line: Rocuronium 1-2 mg/kg IV
   • 2nd line: Succinylcholine 1-2 mg/kg IV. No defasiculating doses.

   Analgesia
   • Fentanyl 0.5-2 mcg/kg IV, initiate continuous infusion at 0.5-1 mcg/kg/hr

   Sedation
   • 1st line: Propofol
   • 2nd line: Midazolam IV boluses, infusion as needed

2. Clinical Evidence/Reasoning:

Pre-Medication: Lidocaine
At this time, the use of lidocaine as a pre-medication to blunt increase in intracranial pressure (ICP) is not recommended due to the lack of evidence supporting its use in rapid sequence intubation (RSI). There is only 1 human trial that evaluates the use of intravenous (IV) lidocaine on ICP during endotracheal intubation. This study done by Bedford et al. evaluated the potential benefit of IV lidocaine at 1.5 mg/kg compared to placebo 2 minutes before endotracheal intubation in 20 patients undergoing elective neurosurgery for cerebral neoplasm. Patients in both groups experienced a transient increase in ICP, but the group pre-treated with IV lidocaine experienced a mean increase in ICP that was 12 mmHg less compared to the placebo group (P <0.05). Limitations of this study include the location of intubation (the operating room) and the other medications used for RSI (induction agent thiopentene, paralytic succinylcholine), which restricting the external validity of this trial for the current ED population. Subsequent reviews that showed an association between lidocaine and decreased ICP were limited to patients who were already intubated, not undergoing RSI. In addition, none of the aforementioned studies

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4 Grover VK, Reddy GM, Kak VK, et al. Intracranial pressure changes with different doses of lignocaine under general anesthesia.
attempted to correlate the lowering of ICP with lidocaine and outcomes. A systemic review done by Robinson and Clancy did not find any publication that supported the proposal that in traumatic brain injury (TBI) treatment with lidocaine before RSI reduces ICP or improves neurological outcome.

**Induction Agent: Etomidate**

Etomidate is considered the ED’s first line induction agent at a dose of 0.3 mg/kg IV (may be capped at 20 mg based on physician preference or dose reduced to 0.15 mg/kg in hemodynamically unstable patients). Etomidate’s fast onset of 10-15 seconds, short duration of 5-10 minutes, and its ability to enhance the effects of GABA without compromising respiratory or cardiovascular drive makes it an ideal induction agent. At this time, a diagnosis of sepsis is not considered an absolute contraindication to the use of etomidate. There is no question that etomidate reversibly inhibits 11-beta hydroxylase and 17-alpha-hydroxylase resulting in decreased cortisol synthesis for up to 72 hours, the clinical significance of this inhibition is unclear. A multitude of studies have looked at 28-day mortality, length of hospital and ICU stay, vasopressor requirements with etomidate vs. placebo or other induction agents with mixed results. The biggest proponent of the negative effects of etomidate on mortality is the CORTICUS trial that found in a post-hoc analysis that patients who received etomidate before randomization had approximately a 13 and 10% increase in mortality in the hydrocortisone and placebo arms respectively. However, CORTICUS only compared the mortality rate of etomidate vs. non-etomidate. It did not compare etomidate vs. other induction agents. Studies that have looked at etomidate vs. other induction agents such as midazolam and ketamine have not found a statistically significant difference in mortality. Of note, while sepsis is not considered an absolute contraindication to the use of etomidate in RSI, providers may want to consider other induction agents such as ketamine in patients with severe sepsis and/or septic shock.

**Induction Agent: Ketamine**

Ketamine is considered the ED’s second line induction agent at a dose of 1-2 mg/kg IV as it provides rapid analgesia, sedation, and amnesia while having limited suppression of respiratory drive. It should be considered first line in patients experiencing shock or asthma/chronic obstructive pulmonary disorder (COPD) exacerbations due its ability to induce endogenous release of catecholamines, increasing heart rate, blood pressure, and bronchodilation. Concerns
paralytic: rocuronium

Rocuronium is the ED’s the first line paralytic at doses of 1-2 mg/kg with an onset of 45 seconds, duration of 30-40 minutes, and minimal contraindications/adverse effects.

Rocuronium has been found to provide optimal intubating conditions (equivalent to succinylcholine) when dosed appropriately at 1-2 mg/kg. In the 2008 Cochrane review meta-analysis, an a-priori subgroup analysis was established look at the outcome of excellent intubating conditions with various doses of rocuronium (0.6, 0.9 or 1.2 mg/kg). Thirty-seven randomized trials were analyzed, with a total of 1409 patients in the rocuronium and 1281 in the succinylcholine groups. In the primary outcome of excellent intubation conditions, there was a statistically significant risk ratio that favored succinylcholine vs. rocuronium (RR 0.86, 95% CI 0.8-0.92). This continued to be true in the a-prior subgroup when looking at rocuronium doses of 0.6-0.7 mg/kg (RR 0.81, 95% CI 0.73-0.9). However, there was no statistically significant difference for excellent or acceptable intubating conditions in the group that received 0.9-1 mg/kg or 1.2 mg/kg of rocuronium (RR 0.96, 95% CI 0.89-1.02). Patanwala et al performed a retrospective analysis on a prospectively collected RSI data set in patients who received succinylcholine (n=113) vs. rocuronium (n=214). Both groups had 100% intubation success with no need for surgical airway, there was no difference in first intubation success (roc 72.9% vs. such 72.6%, p=1.00), and median # of attempts required (roc 1 vs. succ 1, p=0.87). The median dose of rocuronium was 1.19 mg/kg (IQR 1-1.45 mg/kg) vs. succinylcholine 1.65 mg/kg (IQR 1.26-1.95 mg/kg).

paralytic: succinylcholine

Succinylcholine at 1-2 mg/kg IV is considered the ED’s second line paralytic. It should be used a shorter duration of action (<10 minutes) is preferred and no contraindications to succinylcholine exist (history of malignant hyperthermia, risk factors for acute hyperkalemia, extensive denervation of skeletal muscle or upper motor neuron injury). When prolonged paralysis is required, re-dosing of succinylcholine is generally discouraged due to the possibility of a phase 2-muscle blockade.

Paralytic: Defasciculating Doses of Paralytics

This algorithm does not recommend defasciculating doses of non-depolarizing paralytics before the use of succinylcholine to mediate increases in IOP and ICP. There is no definitive evidence that a defasciculating dose of non-depolarizing muscular blocker negates the possible rises in intraocular pressure (IOP) and ICP after the administration of succinylcholine.\textsuperscript{26} Risks include premature apnea and prolonged muscle blockade.

Analgesia + Sedation:

The analgesia and sedation recommendations take into consideration the 2013 Society of Critical Care Medicine Clinical Practice Guidelines for the Management of Pain, Agitation, and Delirium in Adult Patients in the Intensive Care Unit.\textsuperscript{27}

Route of Administration: Intramuscular

When the intravenous and the intraosseous route are not available, specific induction and paralytic agents may be administered via the intramuscular (IM) route at increased doses. These include:

- Ketamine: 4 mg/kg IM
- Succinylcholine: 4 mg/kg IM

Of note, the onset of action of these drugs IM is 2-3 minutes. The onset and duration may be prolonged in those who are hemodynamically unstable. Medications should be administered in the anterolateral thigh to facilitate the fastest onset possible.
