

Using Rapid Sequence Airway to Facilitate Preoxygenation and Gastric Decompression Prior to Emergent Intubation

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A 54-year-old Navajo speaking woman was transferred for management of an inferior ST elevation myocardial infarction. On arrival to the emergency department she complained of shortness of breath but denied chest pain. Her initial oxygen saturation was 93% on a non-rebreather mask at 15 liters of oxygen per minute. Her blood pressure was 79/50 with a heart rate of 104. An EKG revealed ST segment elevations in the inferior leads with reciprocal anterior changes but no evidence of right-sided or posterior involvement. Chest X-ray demonstrated florid pulmonary edema. The patient was diagnosed with acute myocardial infarction, cardiogenic shock and pulmonary edema. During this initial evaluation the patient developed an increase in her work of breathing, agitation, and confusion. Despite a tight fitting NRB mask on 15L oxygen and attempts to calm the patient, her oxygen saturations dropped into the mid-80s and she became increasingly noncompliant with instructions. Emergent intubation was deemed appropriate before transport for emergent coronary catheterization.

During evaluation of the airway, the patient was noted to be morbidly obese with a short neck, small chin, and Mallampati score of three. The specific thyromental distance (TM) and body mass index (BMI) could not be calculated due to the need for emergent intervention. These factors suggested a potentially difficult intubation and difficult bag-valve-mask ventilation (BVMV). Furthermore, her hypoxemia, work of breathing and metabolic demands all put the patient at risk for rapid decompensation and critical hypoxemia- especially in the face of a predicted difficult airway. Although adequate preoxygenation techniques were attempted, the patient's saturation did not improve above 85% and thus noninvasive positive pressure ventilation, assisted ventilation with BVM, and awake oral or nasal intubation were considered. These ideas were abandoned due to the need for rapid intervention, a substantial language barrier and the patient's agitation, which would have required heavy sedation and a subsequent decrease in her oxygenation/ventilation in the face of myocardial ischemia. Furthermore, many options available in the operating room such as inhaled anesthetic gases, fiberoptics or video assisted devices were not available in the emergency department. Therefore, despite the inherent risks of paralysis in a predicted difficult airway, rapid sequence airway (RSA) was performed, with a surgical airway set-up immediately available in case the patient was unable to oxygenate/ventilate once paralyzed. This was done with the intent to better preoxygenate the patient and decompress her stomach in order to facilitate a safer, easier intubation.

All equipment was prepared for a difficult intubation. The patient was induced in her position of comfort (seated) while a ramp was quickly built up behind her. Etomidate and rocuronium were administered and a size 4 LMA-Supreme (LMAS) was easily placed while cricoid pressure was held. During insertion, the patient's oxygen saturation briefly dropped to 83%. This was approximately 2% below her starting level of oxygenation before induction and paralysis. Using the LMA and BVMV with a PEEP valve set at 10, and peak pressures estimated below 25cm H₂O, the oxygen saturations quickly increased to 100%. The stomach was decompressed with a 14 Fr gastric tube

via the gastric tube port on the LMAS which returned approximately 400ccs of stomach contents. With the patient preoxygenated and the aspiration risk decreased, the LMAS was removed and direct laryngoscopy was performed in the ramped position by a first year resident. Cuffed endotracheal tube placement was achieved on the first attempt. The patient's oxygen saturation was maintained at 100% during the entire attempt. There was no evidence of aspiration during direct laryngoscopy or on chest radiograph after intubation. The patient's vital signs remained stable and she was transported to the cardiac catheterization lab for emergent angiography.

Discussion

RSA is a new airway management technique in which the preparation and pharmacology of Rapid Sequence Intubation (RSI) is paired with intentional placement of an EGA, without prior attempt at direct laryngoscopy (DL), even in patients with potentially full stomachs. This technique has previously only been described for primary airway management in the prehospital setting [1]. This is the first report illustrating hospital use of this technique as a preoxygenation strategy and bridge to endotracheal intubation.

Emergent intubation of the hypoxemic patient presents a serious challenge to even the most skilled practitioner. As displayed in the Benumoff curves (Figure 1), hypoxemic patients initially start on the steep section of the oxygen saturation curve and are at risk for

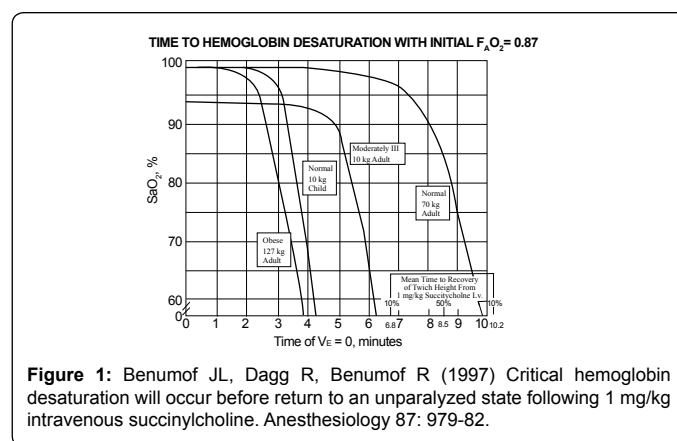


Figure 1: Benumoff JL, Dagg R, Benumoff R (1997) Critical hemoglobin desaturation will occur before return to an unparalyzed state following 1 mg/kg intravenous succinylcholine. *Anesthesiology* 87: 979-82.

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quickly becoming severely hypoxemic during RSI [2]. There may be only seconds before hypoxemia reaches critical levels, depending on underlying pathology, metabolic demands and oxygen reserve. Many patients that would be easily intubated in 90 seconds are impossible to intubate without significant hypoxemia in this brief interval. If the first attempt is unsuccessful, multiple intubation attempts may ensue, which has been associated with a substantially increased risk of hypoxemia and other complications[3]. In patients with neurological injury, hypoxemia has been associated with a worse outcome and increased mortality [4] It is therefore imperative to have a plan in place to improve preoxygenation and reduce further hypoxemia.

Preoxygenation usually involves a mentally alert patient breathing oxygen via a non-rebreather for 5 minutes [5]. This is based upon the ability to create an oxygen reserve through nitrogen washout. Patients who remain hypoxemic after pre-oxygenation have no effective reserve to allow for paralysis and apnea without further deterioration in oxygen saturation. Research has demonstrated that patients with an oxygen saturation of 93% or less after preoxygenation will always desaturate during RSI [6]. Attempting RSI in such patients creates a situation in which the intubator has very little time before the patient becomes critically hypoxic; this stress alone may reduce success rates.

For the above reasons, many hypoxemic patients - like the one in our case report - will require PPV to facilitate preoxygenation and allow for safe intubation. While this is commonly performed with a BVM, it is not without limitations. BVMV can be very challenging in some patients, even in experienced hands [7] and may not allow for reliable PEEP. Known predictors of difficult BVMV include the following: age over 55, obesity, shorter thyromental distance, prior neck radiation, male sex, sleep apnea, Mallampati III or IV and facial hair[7,8]. BVMV in hypoxemic obese patients may require substantial airway pressures that result in gastric insufflation without the ability to facilitate gastric decompression. Thus, given the need for PPV and these risks, RSA with the proper EGA provided a mechanism for both preoxygenation and gastric decompression in our patient.

In the last several years, EGAs have evolved tremendously. There are now several disposable devices available which offer excellent seal pressures and the ability to easily pass a gastric tube. These include the Esophageal-Tracheal Combitube, EasyTube, LMA-Supreme and King LTS-D. None of these devices has been shown to be clearly superior in this setting. Additionally, there are intubating laryngeal airways available (LMA-Fastrach and AirQ) which could allow for both facilitated preoxygenation and facilitated intubation without removal, though neither of these devices allow for gastric decompression.

Another technique recently described to maximize preoxygenation is Delayed Sequence Intubation (DSI) [9]. This approach employs a sedative to relax a patient and allow for more controlled PPV using either a BVM or vent-to-mask technique. Ideally an agent that maintains airway reflexes, such as ketamine or dexmedetomidine, would be utilized. DSI would not, however, be a good choice when you anticipate difficulty with BVMV.

We acknowledge that many practitioners would choose succinylcholine over rocuronium in a anticipated difficult airway due to its shorter duration of action. However, the patient was in extremis before intubation due to respiratory and cardiac failure. Had a failed airway occurred, allowing the paralytic to wear off would not have been a viable option; instead a surgical cricothyrotomy would have been performed. A surgical airway is better performed with complete paralysis and the duration of succinylcholine may have led to reversal and patient movement during the procedure requiring further dosing. The pharmacokinetics of rocuronium allow for single dosing in this situation.

In summary, we describe a novel approach to emergent intubation of the hypoxemic patient. This approach involves using Rapid Sequence Airway with an extraglottic airway for planned positive-pressure pre-oxygenation and gastric decompression as a bridge to safer intubation. This technique warrants further evaluation.

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