



HCTA Newsletter

Volume 4 Issue 1

April 2001

Endotracheal Intubation:

Oral Vs. Nasal Route

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Definitive, and timely, airway management is essential to the effective care and resuscitation of a trauma victim. There is little doubt as to why "airway" is listed first in both the advanced cardiac (ACLS) / basic life support (BLS), and advanced trauma life support (ATLS) algorithms. Unless the patient's airway is maintained patent there will be little hope of successful resuscitation. The advantages of endotracheal intubation are numerous, and include; maintaining patency of the airway, protecting against gastric aspiration pneumonitis, reducing anatomic dead space, and facilitating tracheo-bronchial hygiene with the clearance of secretions. Perhaps even more important, endotracheal intubation allows for the delivery of positive pressure ventilation to the lungs without inflation or, and distention of the stomach. This article will attempt to review some of the basic concepts regarding oral vs. nasal intubation, as well as each of their potential drawbacks.

INDICATIONS: Endotracheal intubation is definitely indicated for patients who have been severely traumatized, either by blunt or penetrating mechanisms of injury. In addition, victims with an initial Glasgow Coma Scale (GCS) less than 8 should have their airway secured. Endotracheal intubation is also recommended for any patient at increased risk for gastric aspiration, and subsequent development of aspiration pneumonitis. Moreover, any patient who suffers severe electrical or thermal burns, with or without life-threatening smoke

inhalation should be evaluated for intubation. If the patient's traumatic injuries, or pathophysiologic derangements make surgery necessary, then endotracheal intubation will become necessary in order to facilitate general anesthesia. These may include some or all of the following; altered mental status, severe hemodynamic compromise, disruption of the normal bio-mechanics of respiration (e.g., flail chest with underlying pulmonary contusion, penetrating chest wounds, and diaphragmatic rupture). Finally, the need for postoperative and/or prolonged mechanical ventilatory support will also require maintenance of a secured airway.

GENERAL PRINCIPLES: The method, and route, of endotracheal intubation depends on the type and severity of the injury, as well as the planned surgical intervention. Routine evaluation of the patient's upper airway should include: ability to open the mouth, quality and quantity of dentition, size and shape of the tongue, patency of the nasal passages, anatomic variations of the facial/jaw skeleton (e.g., micro- or macro-gnathia), and status of the cervical spine. Anatomic variations which might make endotracheal intubation more difficult include: protruding upper incisors, a receding mandible, temporomandibular joint dysfunction, a high-arched/narrow palate, and cervical osteo-/rheumatoid arthritis. Any chipped, diseased, loose or missing teeth should be identified and cataloged as soon as possible to avoid confusion later on in the patient's hospitalization. Further, the presence or absence of dental bridges, partial plates and/or orthodontic appliances should be noted. Teeth with caps and crowns are at increased risk for dislodgement during laryngoscopy, and need to be protected if feasible. Moderate-to-severe periodontal disease will also increase the risk that permanent or temporary dentition may become dislodged during airway management.

Before induction of anesthesia, the healthcare personnel should have all necessary equipment available. The intubation equipment should include the following; laryngoscope handle and assorted blades of different types / sizes, various sizes of endotracheal tubes, malleable stylets, MacGill forceps, lubricants, an inflating syringe, tongue blades, oro- and nasopharyngeal airways and suction apparatus. An endotracheal tube of appropriate diameter and length should be selected for the trauma victim. For example, a #7.0 or 7.5 oral endotracheal tube is usually appropriate for a grown adult female, whereas an #8.0 or 8.5 oral tube is chosen for an adult male. However, the size of the tube must often be downsized by #0.5 to 1.0 if the nasal route is selected, since the patient's nasal passages may not accept the bigger size and epistaxis might occur with insertion of the bigger tubes. The cuff of the endotracheal tube should always be checked for patency, so that there is no detectable leak. Also, one must be careful that the malleable stylet is not extending outside of the distal end, because this may cause accidental vocal cord or tracheal injury. The tube should be kept in the manufacturer's sterile wrapper until it is ready to be inserted. This should reduce the risk of iatrogenic tracheo-bronchitis seen with excessive handling of the endotracheal tube prior to insertion.

'CURVED' VS. 'STRAIGHT' BLADE

TECHNIQUES: The advantages of the curved (i.e., 'Mac' or 'Macintosh') blade relate to the sensory innervation of the laryngeal and/or interior surface of the epiglottis. Here sensory innervation is derived from the superior laryngeal branch of the vagus nerve. Stimulation of the epiglottis by the straight (i.e., 'Miller') blade beneath the epiglottis is said to predispose to laryngospasm and cough. The pharyngeal or superior surface is innervated by the glossopharyngeal nerve. When stimulated it seems to be less likely to trigger spasm, and/or paroxysms of cough. The curved blade also allows more room between the teeth for passage of the endotracheal tube. At times the exposure of the glottis may not be as good as obtained with the straight blade, however, this can usually be overcome with gentle cricoid pressure and/or use of a stylet. The curved blade is superior when the patient's mouth cannot

be opened widely, or they have very poor dentition. In contrast, the straight blade is preferred when intubating young children under the age of five years, or in those with oropharyngeal masses (e.g., squamous cell cancer at the base of the tongue). Common reasons for difficulty or inability to visualize the glottic aperture include some, or all of the following; improper placement of the laryngoscope blade (e.g., inability to move the tongue to the left side), abnormal head position (e.g., excessive flexion or extension), insufficient depth of general anesthesia, inadequate depth of neuromuscular blockade, and insufficient knowledge of airway anatomy.

NASOTRACHEAL INTUBATION: The nasal route is commonly chosen when the patient's mouth cannot be easily opened (e.g., trismus), or when the jaw is obviously fractured. It is, likewise, avoided when the patient demonstrates evidence of a basilar skull fracture, nasal fracture with or without associated sinusitis, or nasal obstruction. The technique can be used with the patient awake, but slightly sedated, or under general anesthesia with or without the use of neuromuscular blockade. It may be performed under direct vision, or with a 'blind' technique. Either approach requires that the endotracheal tube be soft and pliable, so that the nasal mucosa and/or turbinates not be injured. In the hospital setting we frequently administer topical vasoconstrictors to shrink the vascular nasal mucosa, and minimize bleeding. Unfortunately, the urgencies of time make the application of vasoconstrictors a useful, but optional modality. The tube itself must be well lubricated, and inserted with its prefabricated concavity facing forward. After initial passage into the nare, subsequent insertion should be done very slowly and with only a minimal amount of force. Rapid, forceful maneuvers, large-bore, rigid endotracheal tubes, and lack of lubrication may result in severe epistaxis. This bleeding usually becomes problematic, since it can trigger laryngospasm and/or make subsequent attempts difficult, if not impossible. In an awake patient, voluntary hyperventilation is frequently helpful in facilitating the passage of an endotracheal tube through the vocal cords. This phenomenon occurs, because deep inspiration

results in maximal abduction of the vocal cords. Entry of the tube into the larynx is frequently accompanied by a transient loss of breath sounds as the patient breath holds, or an episode of frank coughing induced by irritation of the tracheal wall. Helpful guides to successful insertion include; observance of the patient's neck for bulging produced by the tip of the endotracheal tube stretching the wall of the hypopharynx, increased or decreased breath sounds, and resistance to further passage. Whether insertion is via the oral or nasal route, NEVER force an endotracheal tube if it meets resistance, since catastrophic vocal cord rupture or perforation of the hypopharynx / trachea may result. Other useful adjuncts to consider in facilitating successful nasal intubation include some or all of the following; use of MacGill forceps, inflation of the cuff of the nasal endotracheal tube after emerging from the nare into the hypopharynx (i.e., this directs the tip of the endotracheal tube anteriorly towards the vocal cords), and use of a 'trigger' tube which has a thin plastic cable attaching the distal tip to the proximal, circular trigger (i.e., this also allows the tube to be ante-flexed towards the vocal cords).

Theoretical advantages of nasal endotracheal intubation include; (1) easy fixation to the upper lip and/or maxilla, (2) less discomfort since nothing sits on or near the tongue triggering the gag reflex, (3) less occlusion from biting on the tube, (4) less accidental / self extubation, and (5) better oral hygiene. In contrast, proposed disadvantages of the nasal route include; (1) increased airway resistance and work of breathing secondary to the smaller sizes employed, (2) potential damages to nasal structures, (3) possible insertion into the cranial vault if the cribriform plate is disrupted (e.g., basilar skull fracture), (4) higher rates for sinusitis, and (5) difficulty in suctioning out all retained secretions.

DISCUSSION: In victims of severe blunt or penetrating trauma, concern must always be demonstrated for the structural integrity of the neuro-axial skeleton (i.e., cervical and thoracic spine). Most if not all of these trauma victims, have their cervical spine immobilized at the scene with a rigid collar and bilateral head/neck support after

they are positioned on a long, hard spine board. This immobilization tends to make direct laryngoscopy more challenging. Some researchers have reported in the literature that oral intubation in the patient with multiple organ system trauma does not increase the incidence of adverse neurologic events.¹ Other healthcare personnel have argued that nasal intubation should be the preferred initial approach for patients at risk for cervical spine injury. Of note, however, studies conducted in cadavers which utilized advanced fluoroscopic techniques could not prove any superiority of one technique over the other.² The authors of the study found similar distraction on the unstable C₁ - C₂ segment of patients who had suffered odontoid fractures. Interestingly, they reported that pre-intubation maneuvers, such as jaw thrust and chin lift, may cause more compromise of the cervical spine than direct laryngoscopy. Axial traction has been advocated as a means of protecting the unstable cervical spine during airway manipulation and/or direct laryngoscopy. Unfortunately, recent data brings its usefulness into question, and suggests that it might even be harmful under certain circumstances.³ In the hospital setting, awake fiberoptic intubation techniques minimize the amount of cervical movement and force placed on the spine. Its application in the field to trauma victims is obviously impractical, so we will defer any further comments on its utility.

Another frequent question that is often raised about oral and nasal endotracheal intubation revolves around whether one technique is preferable in patients with increased intracranial pressure. This phenomenon may result from a variety of traumatic injuries (e.g., blunt head trauma, falls, and blast injuries) and non-traumatic disease (e.g., benign / malignant brain tumors, intra-cranial hemorrhage). The cranial vault (i.e., the "skull") basically contains three major components; (1) brain matter = 85%, (2) blood = 5%, and (3) cerebrospinal fluid (CSF) = 10%. When the brain is injured, by whatever mechanism, there is very little room inside the cranial vault to accommodate swelling and/or bleeding. This is referred to as the swollen brain exceeding its critical "inflection point" at which any given increase in volume will result in a

disproportionate increase in intracranial pressure. If the pressure within the skull becomes too high, then the brainstem may herniate through the foramen magnum at the base of the cranium into the spine. This is usually fatal, since it will interfere with the involuntary vital functions performed by the medulla and pons. Another deleterious aspect of abrupt rises in intracranial pressure is the decrement in a patient's cerebral perfusion pressure (CPP).

[Cerebral perfusion pressure (CPP) = Mean arterial pressure (MAP) - Intracranial pressure (ICP)]

Any decrease in CPP may ultimately result in a diminution in oxygen delivery to the neurons themselves. Thus, it is vital for the first-responders to achieve two simultaneous goals in regards to optimal patient management; (1) *maximize* mean arterial pressure through blood and fluid resuscitation, and/or the use of inotropes or vasopressors, and (2) *minimize* any increase in intracranial pressure.

Extensive medical research over nearly three decades has concluded that the actual route of endotracheal intubation plays little, or no role in increasing the patient's intracranial pressure. Instead, what matters most is the depth of anesthesia which is obtained during intubation attempts. If, for whatever reason, the patient is only lightly anesthetized, then they are much more likely to experience abrupt increases in ICP as a result of sympathetic nervous system stimulation. On the other hand, when the patient is adequately anesthetized and sedated, then both oral and nasal intubations can be performed without any noticeable increase in ICP. As was previously mentioned, oral intubation may prove difficult or impossible in some cases secondary to the immobilization of the cervical spine. Likewise, nasal intubation should be avoided in any patient with signs or symptoms of basilar skull fracture, mid-face fracture, or active sinusitis. How then should the healthcare provider handle this challenging dilemma? Well, first of all remember that any abrupt rise in carbon dioxide will increase ICP as a result of direct arterial vasodilation of the blood vessels supplying the head. Thus, even

simple, effective ambu-bag ventilation may be very effective at controlling the acute rise in ICP. Gentle hyperventilation will acutely lower the individual's arterial CO₂ (PaCO₂). The resultant iatrogenic hypocarbia causes arterial vasoconstriction which will further limit blood flow into the head, and thereby drop the patient's ICP. The rescuer should be discouraged from spending an inordinate amount of time with either oral or nasal intubation at the expense of effective manual ventilation with bag and mask. Unfortunately, many healthcare personnel consider ambu-bag ventilation either not "glamorous enough," or simply "superfluous." The 5-to-10 minutes lost in an unsuccessful intubation attempt may, however, cause irreparable CNS injury and cell death. Often this type of damage could be avoided, or at least minimized, by the conservative airway management techniques described in the ATLS course. It is worth re-emphasizing that the first, and foremost goal of airway management should be to maintain adequate oxygenation (i.e., PaO₂ > 60% ~ SpO₂ > 90%) and ventilation (i.e., PaCO₂ < 40 mm Hg) prior to, and during any attempts at endotracheal intubation. Although there are other alternatives to lowering a patient's elevated ICP, neither surgical techniques (e.g., craniotomy) nor pharmacologic interventions (e.g., mannitol) have any practical role outside the hospital environment, so we will not spend any time reviewing them in this article. Several excellent reviews are available in the medical literature which addresses them in comprehensive detail.⁴

Although 'blind' nasal intubation has been utilized for almost a century, a recent study from England found that non-anesthesiologists, who were fully ATLS certified personnel (i.e., first responders) had a very poor success rate of less than 10%.⁵ Among anesthesiologists specifically trained in 'difficult' airway management, the success rate was much higher. Sheaver, et al., reported on patients who were intubated after suffering severe penetrating trauma to the neck.⁶ They found a fiberoptic and surgical airways resulted in virtually a 100% success rate, direct laryngoscopy with one or more blades was successful in 98% of attempts, and blind nasal intubation in only 75% of the cases. This relatively poor success rate was seen with the nasal

