WILDERNESS & ENVIRONMENTAL MEDICINE (2018) ▮, ▮▮▮–▮▮▮

CONCEPTS

An Experience of Improvised Laryngoscopy

Alison Matthews, MD, FAWM

From the University of Chicago, Chicago, IL; and the NorthShore University HealthSystem, Highland Park, IL.

Airway management in the wilderness runs the gamut from basic airway support to endotracheal intubation. Fortunately, direct laryngoscopy is a seldom called upon skill in expedition medicine. However, the medical skills required during a mission or expedition are never truly known in advance. Improvisation during evolving medical events is a mainstay of expedition medicine education and practice. It is unlikely, given constraints of weight and size of expedition medical kits, that a conventional laryngoscope would find its way into a standard "go bag." Faced with the real but rare event of needing to intubate a patient in an austere environment, how can improvisation be used? Multiple ideas for improvised laryngoscopes can be found in the wilderness medicine literature, but which, if any, of these devices have true clinical utility? To this end, participants of a recent Wilderness Medical Society preconference in medical elements of light search and rescue were given the opportunity to devise and construct their own improvised laryngoscopes and attempt intubation of a training mannequin. Participants with varying degrees of intubating experience improvised effective laryngoscopes from provided materials and successfully intubated an airway mannequin.

Keywords: airway management, endotracheal intubation, laryngoscope, equipment design, wilderness medicine, expeditions

Introduction

Airway management skills in the wilderness range from simple supportive measures, such as a chin lift/jaw thrust maneuver, to intubation of the trachea.[1–4] Between these 2 extremes are any number of airway techniques and devices, including oral airways, nasal airways, tongue traction, and extraglottic airways (i-gel, Combitube, King tube, laryngeal mask [LMA], intubating LMA). Although these airway interventions may be sufficient to improve oxygen exchange and carbon dioxide removal, they do not protect from aspiration of gastric contents. Placement of an endotracheal tube is the only way to provide a secure and controlled airway in a patient requiring ventilatory support. Endotracheal tubes can be placed blindly via a nasal approach, digitally with fingers palpating the glottic opening, under direct visualization using a laryngoscope, or via cricothyrotomy.

Direct laryngoscopy is a rarely called upon skill in expedition medicine. However, the anticipated goals of the planned mission may evolve and change during execution. When responding to disaster situations it can be impossible to know in advance what equipment will be at one's disposal in the affected region. Practicing medicine in an austere environment, whether in a hospital setting in the developing world or during a disaster response with limited resources, requires flexibility of mindset and use of available resources. Necessity is oftentimes the mother of invention. Seeing common, ordinary objects in a new and unique light can be lifesaving. No matter the limitations of a given situation, our hands, our minds, and our improvisation skills are at our disposal wherever we are called to respond. Simulation-based training can be used to explore innovations, develop medical skills, and build confidence before actively practicing medicine in an austere environment.

Corresponding author: Alison Matthews, MD, FAWM, NorthShore University HealthSystem, 777 Park Avenue West, Highland Park, IL 60035; e-mail: amatthews1@uchicago.edu.

Submitted for publication October 2017.

Accepted for publication May 2018.

Background

The first documented airway intervention was a tracheostomy dating back to the Bronze Age and described in the ancient Indian text *Rig Veda*. Subsequently, pioneering Egyptian physicians recorded use of surgical tracheostomy to relieve an upper airway obstruction. Greek

and Roman literature of the early modern epoch reports additional instances of the life-saving use of tracheostomies. This knowledge of airway management was apparently "lost" in the intervening years and "rediscovered" during the Renaissance. During the 19th century, the unfortunately frequent circumstances of drowning and diphtheria led to a resurgence of these airway techniques being taught and utilized. This fascinating history was compiled by Szmuk et al in their article, "A brief history of tracheostomy and tracheal intubation, from the Bronze Age to the Space Age."[5]

In a parallel fashion, during the late 19th century, the anesthetic world was evolving and developing nonsurgical airway interventions. Central among these innovations was direct laryngoscopy, a technique used to visualize the structures of the larynx. Most commonly, this procedure is used to facilitate endotracheal intubation, but it may also be used to evaluate the larynx for tumors, anatomy, foreign bodies, trauma, and nerve or structural injuries. The process of direct laryngoscopy was first published in 1895.[6] However, endotracheal intubation was not detailed until 1913[7] and was not commonly performed for surgical procedures until the mid-20th century. Further advancements by McGill, Macintosh, and Miller led to the laryngoscopes in common use today.

Informed by the progress in prehospital and combat casualty care, airway management in wilderness and expedition medicine has grown and developed. From basic supportive measures and mouth-to-mouth respiration, airway interventions in austere environments now include the full spectrum of care from the recovery position to surgical cricothyrotomy. Along with this advanced scope of practice, wilderness medicine practitioners have developed ways to improvise various airway adjuvants when necessary.

Improvised airway management

Airway management begins with the most basic interventions to assist and protect the patient's airway and ends with definitive airway control. Along this spectrum are any number of conservative measures before resorting to endotracheal intubation. The decision to move forward with intubation of the trachea is a major commitment to the patient and not to be made lightly. Once an endotracheal tube is placed, the patient will require 24-h support until definitive care is reached. This raises significant questions about the feasibility, duration, and difficulty of evacuation. Also to be considered is the ability of the team to meet these demanding evacuation requirements while ensuring the health and safety of the other team members. Before proceeding with intubation, consider if this is a realistic commitment.

With these caveats in place, a discussion of the various airway interventions that can assist with ventilation, oxygenation, and protection of a patient's airway can proceed. Included are techniques for improvising a range of devices, from the simplest to the most complex. If advanced airway management is warranted, several methods for intubation are described including an improvised endotracheal tube. Table 1 summarizes these techniques.

The most basic airway intervention is the recovery position.[8] The patient is gently rolled to either the right or left lateral decubitus position with the dependent hand and forearm cradling the head. Provided the patient does not have a cervical spine injury, this is a safe position that helps maintain a patent airway and reduces risk of aspiration due to secretions or vomitus.

If the patient cannot be moved or airway obstruction continues, the next maneuver is a chin lift and jaw thrust. Care should be taken to maintain a neutral cervical spine with each of the actions. A chin lift is simply that: elevating the patient's chin by applying pressure below the chin and lifting slightly upward. This will have limited utility as the lifting action will soon begin to lead to cervical spine extension. Additionally, a jaw thrust can be used. The index and middle fingers are placed behind the angle of the mandible, and gentle traction distracts the mandible anteriorly. This can be achieved with little or no cervical extension. Maximum benefit of the jaw thrust maneuver is achieved once the lower incisors are displaced forward of the upper incisors (a profound underbite).[9]

If these interventions do not relieve the obstruction, a remedial airway intervention is the next step. Oral airways can be inserted to lift the tongue off the posterior oropharynx to relieve an airway obstruction.[1] The C-shaped device comes in various sizes. The appropriate size is determined by the distance from the corner of the mouth to the angle of the mandible. Using a tongue blade to depress the tongue, the airway is inserted following the curve of the tongue to the posterior oropharynx. Without a tongue depressor, the airway should be inserted with the tip pointing upwards toward the hard palate. The airway is inserted and slowly rotated 180 degrees following the curve of the tongue. A disadvantage of this intervention is that it can stimulate the airway reflexes of a conscious patient and cause vomiting and laryngospasm. Oral airways are more difficult to improvise as tubing can be compressed with biting, leading to secondary airway obstruction. Additionally, the tube needs to be secured to prevent