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Review

Awake fiberoptic intubation: A narrative clinical review based on the Cleveland Clinic experience

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ABSTRACT

Background.

Awake fiberoptic intubation is an indispensable technique that every anesthesiologist should be familiar with. Adequate topicalization, sedation and hand-eye coordination results in a safe, smooth, painless, and anxiety-free intubation for the patient. On the other hand, if the anesthesiologist does not take the time to prepare and perform the procedure adequately, it can be a very traumatic experience for all involved.

Aim of this review.

There are many techniques to topicalize the airway, administer sedation, and perform an FOI. In this article we aim to describe the various educational aspects and techniques required to perform a safe awake fiberoptic intubation as well as preferred methods of our ENT anesthesiologists at our institution The Cleveland Clinic. We hereby describe data regarding the number of awake fiberoptic intubations performed, and present the techniques utilized at our institution, The Cleveland Clinic. With over 9000 awake fiberoptic intubations performed at our institution, The Cleveland Clinic, since 2006 we thoroughly describe what is required to perform a successful awake fiberoptic intubation.

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1. Introduction

Securing the airway is essential for many surgical procedures and airway expertise is considered a priority for anesthesiologists. Airway management requires individual skills, experience, and regular (re-) training. Severe airway complications are rare, however many events associated with airway management failure in the operating room have led to death or brain damage[1,2]. Even when ultimately successful, difficult intubation is associated with significant patient morbidity and mortality. Complete failure to intubate the airway is rare; however multiple intubation attempts are common, occurring in up to 8% of patients[3]. Repeated intubation attempts are clearly associated with respiratory and hemodynamic complications, including hypoxemia, cardiac arrest, gastric regurgitation, aspiration, and airway trauma[4–6].

Awake fiberoptic intubation (FOI) is one of the recommended strategies to secure an expected difficult airway [7,8]. If adequately performed, it is a safe, painless, and successful technique. Consequently, anesthesiologists should be familiar with this technique and be able to safely perform it.

Within our Anesthesiology Institute at Cleveland Clinic, we have performed 8821 awake intubations from 2006 to 2019, an average of 630 awake intubations per year (data recorded from our automated anesthesia record keeping system). We did not record any major complications and none of the awake intubation procedures have been aborted during this time period. In this review we discuss indications for awake FOI, anatomy, and equipment as well as techniques for sedation, topicalization and performance of successful awake FOI that we utilize at our institution, The Cleveland Clinic.

1.1. Indications, Relative Contraindications & Complications of FOI

The need to perform an FOI often arises due to special circumstances, challenging clinical situations, and specific airway features [7–9]. Common indications for FOI are listed below in Table 1 and relative contraindications listed in Table 2 [2,7–9].

Complication rates associated with awake or asleep FOI have been reported to be as low as 1.6% and as high as 15.7%. This broad range is due to variations in how different studies assess complications. The most common complications reported included mucus plugging, discovery of cuff leak after intubation, inadvertent extubation, multiple intubation attempts, and desaturation[10,11].

Other airway complications associated with FOI include sore throat, hoarseness, laryngeal trauma, laryngospasm, airway bleeding, and epistaxis[1,12–14]. Tracheal and gastric perforation resulting in pneumomediastinum have also been reported[15–17]. Drug related complications include over sedation leading to hypoxia. A further drug complication includes the potential for local anesthetic systemic toxicity, especially when the lidocaine dose used for topicalization exceeds 9 mg/kg lean body weight[18,19]. Lastly, intubation failure rates have been reported in the 1–2% range and are often related to the inability to pass the tracheal tube (TT) despite having successful passage of the scope shaft through the glottis[7,10,11,20].

1.2. Innervation of the airway

1.2.1. Nasal innervation

The innervation of the nasal cavity originates principally from two sources, the *sphenopalatine ganglion* – (sphenopalatine nerves, branches of the maxillary division of the trigeminal nerve) which innervates most of the cavity including turbinates and septum, and the *anterior ethmoid* (ophthalmic division of the trigeminal nerve) which provides sensory innervation to part of the anterior portion of the nares. Fig. 1 illustrates the branches of the trigeminal nerve.

1.2.2. Oral innervation

The *glossopharyngeal nerve* provides sensory innervation to the posterior third of the tongue, vallecula, anterior surface of the epiglottis, posterior and lateral walls of the pharynx, and the tonsillar pillars. The glossopharyngeal nerve can be localized by simple topicalization. It can also be anesthetized by injecting local anesthetic at the base of the tonsillar pillars. This technique is known as a glossopharyngeal nerve block.

1.2.3. Laryngeal innervation

The innervation of the laryngeal inlet derives primarily from the *superior laryngeal nerve*. It supplies innervation to the base of the tongue, vallecula, epiglottis, aryepiglottic folds, arytenoids, and

Table 1
Indications for FOI.

Documented or known difficult intubation and/or face mask ventilation
Anticipated or suspected difficulty in airway management based on history, physical examination, and assessment of airway features
Cervical spine instability necessitating neurological examination post intubation
Abnormal anatomy, dysmorphic facial features and altered airway patency including but not limited to congenital airway deformities, head and neck tumors, post head and neck radiation state and airway trauma.
Patients at increased risk of aspiration and potential for difficult airway management or who are unable to tolerate a period of apnea

Table 2
Relative contraindications for FOI.

Intractable airway bleeding that obscures airway visualization
Copious secretions as may occur in pulmonary edema
Local anesthetic allergy or sensitivity
Ongoing hypoxia
Inability to cooperate due to drug intoxication (alcohol, cocaine), age (children), or impaired mental development (Down's syndrome, cerebral palsy)
Presence of raised intracranial pressure with active vomiting or wherein coughing may increase risk of herniation.
Critical airway compromise such as a stridulous patient who may benefit from front of neck access
Inexperienced proceduralist or inadequate training/skill.

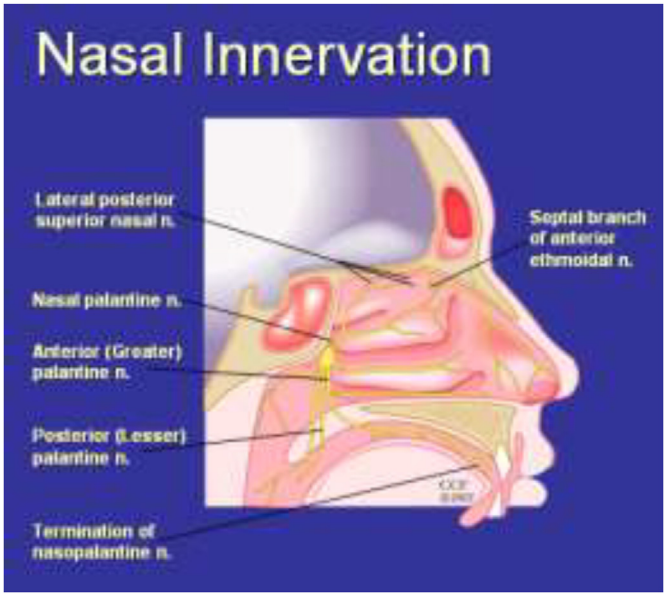

Fig. 1. Nasal innervation.

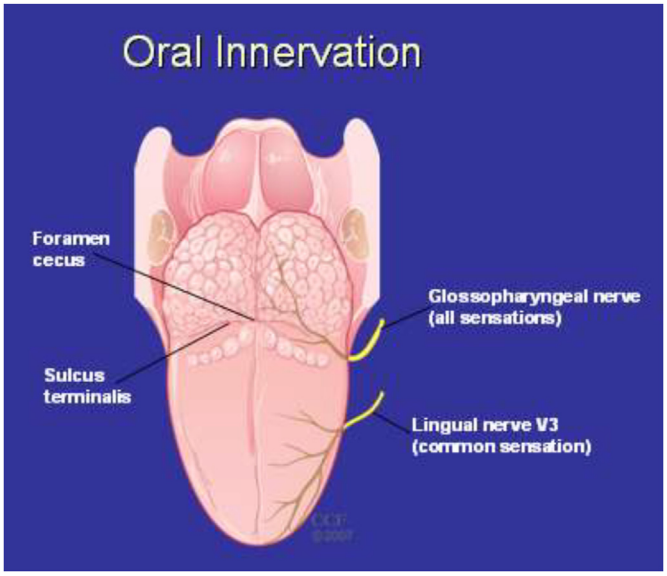

Fig. 2. Oral innervation.

down to (but not including) the vocal cords. It originates as a branch of the *vagus nerve* that lies deep to the carotid artery. It then travels anteriorly at the level of the hyoid bone. The nerve branches into the *internal* (sensory) and *external* (motor) branches. The internal branch pierces the thyrohyoid membrane and enters a space just below the mucosa covering the pyriform fossa and the pre-epiglottic space. The external branch provides motor innervation to the cricothyroid muscle. The superior laryngeal nerve may be anesthetized using simple topicalization or via a superior laryngeal nerve block. This is achieved by placing local anesthetic beneath the greater cornu of the hyoid bone bilaterally (Fig. 3).

1.2.4. Trachea and vocal cords

The sensory innervation of the trachea and the vocal cords is provided by the *recurrent laryngeal nerve*, a branch of the *vagus nerve*. The recurrent laryngeal nerve provides motor innervation to all muscles of the larynx except the cricothyroid muscle. Again, it may be anesthetized using topical anesthesia or via a *trans*-tracheal block, where local anesthetic is placed in the trachea after piercing the cricothyroid membrane.

1.2.5. Sedation for awake intubation

The concept of FOI is unpleasant and will frequently cause anxiety to patients. The goal of sedation for FOI is to create a patient who will be comfortable, cooperative, yet stable from a hemodynamic and respiratory standpoint. In concert with good airway anesthesia, sedation provides a comfortable and “non-memorable” FOI experience. Regardless the drugs used, it is recommended to maintain a level of moderate sedation, as recommended by ASA and ESAIC[21,22]. Furthermore, there is no evidence of a superior sedation technique or drug in term of safety and efficacy for awake FOI.

Although there are multiple sedation options available for awake FOI, the providers at our institution predominantly use one of three techniques:

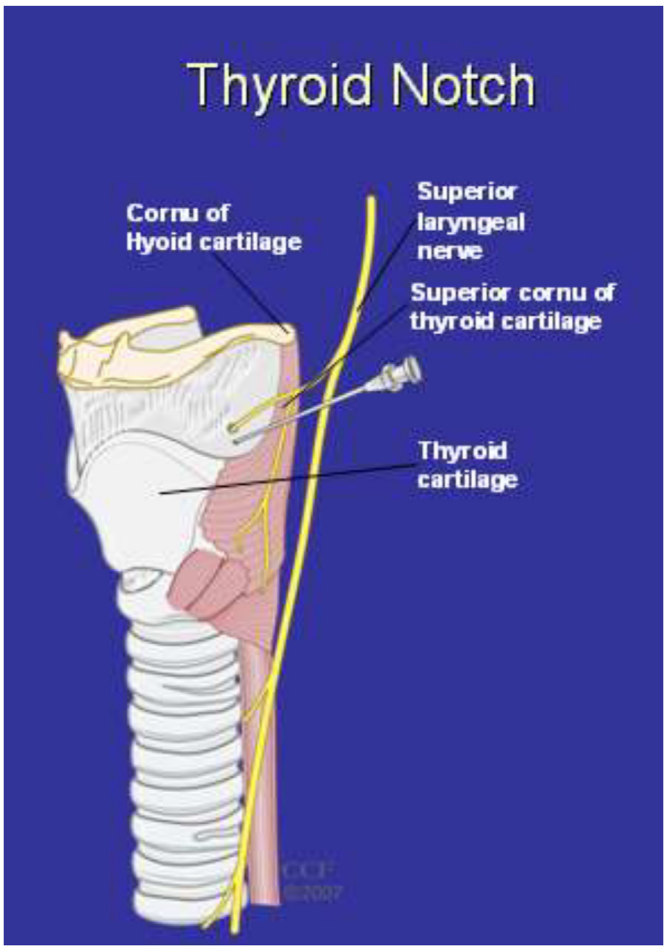

Fig. 3. Thyroid notch.

1. Midazolam and Fentanyl – This is the most frequently used technique. These drugs are titrated judiciously to achieve the desired level of sedation. Both drugs have reversal agents that can be administered if oversedation occurs. The benzodiazepine, Midazolam is usually given in .5 mg–1 mg doses to achieve the desired level of anxiolysis[22]. The narcotic, Fentanyl serves as an analgesic, antitussive as well as an inhibitor of airway reflexes [23]. The fentanyl is administered in 25 μg–50 μg doses. Both drugs are titrated in such a manner that the patient is awake, breathing, and cooperative with the practitioner who is performing awake FOI.
2. Dexmedetomidine – When the short acting α-2-adrenoceptor agonist dexmedetomidine was first described, it was thought to potentially be the ideal agent for awake intubation. In addition to providing anxiolysis and analgesia, dexmedetomidine sedates patients in a way they are easily aroused when stimulated. It results in minimal respiratory depression as well as reducing salivary secretion[24]. The most common practice in our institution is to start anesthetizing the airway while the patient is receiving the 1 μg/kg IV loading dose (generally over 10–20 min). Once the bolus has been administered, the infusion is commenced at 0.7 μg/kg/hr[25]. The infusion is usually terminated once the intubation is complete, and anesthesia has been induced.
3. Remifentanil – Remifentanil is an easily titratable potent short acting narcotic. It provides profound analgesia, suppresses airway reflexes, and has minimal effect on cognitive function [22]. As compared to the other techniques there is no amnesia so the patients may recall the intubation but it is often not perceived as an unpleasant event[22]. The continuous infusion is started at 0.075 μg/kg/min – 0.15 μg/kg/min during the process of anesthetizing the airway. By the time the patient is ready for intubation a steady state has been reached.

1.2.6. *Equipment for FOI*

The successful performance of an FOI requires good quality functioning equipment. The following is a description of the essential equipment needed.

1.2.7. *Flexible intubating bronchoscope*

The flexible bronchoscope is the key price of equipment used to perform a FOI[26]. The fiberoptic scope allows vizulazation and localization of the airway and acts a conduit for the passage of the TT. Scopes may be reusable or disposable. Scopes come in many different lengths and sizes[27].

A scope consists of (Figs. 4 and 5).

- A cord holding optical fibers or a camera at the tip to transmit images
- An eye piece or camera head to view images
- A light source
- A working chanel to suction, administer oxygen or local anesthetic
- A control lever for extending and flexing the tip
- Working tip (channel, light source, camera)

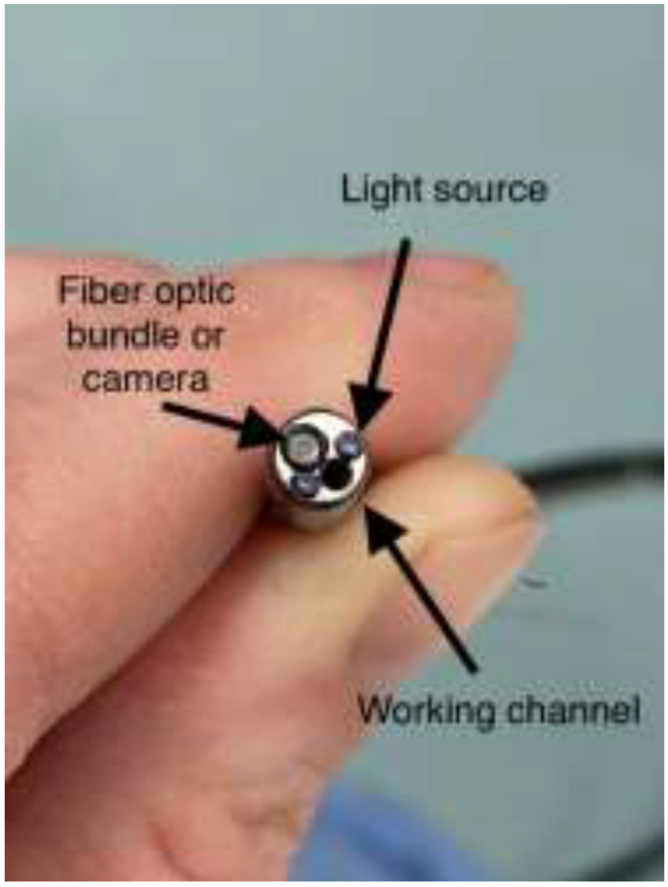

Fig. 4. Working tip of the Scope.

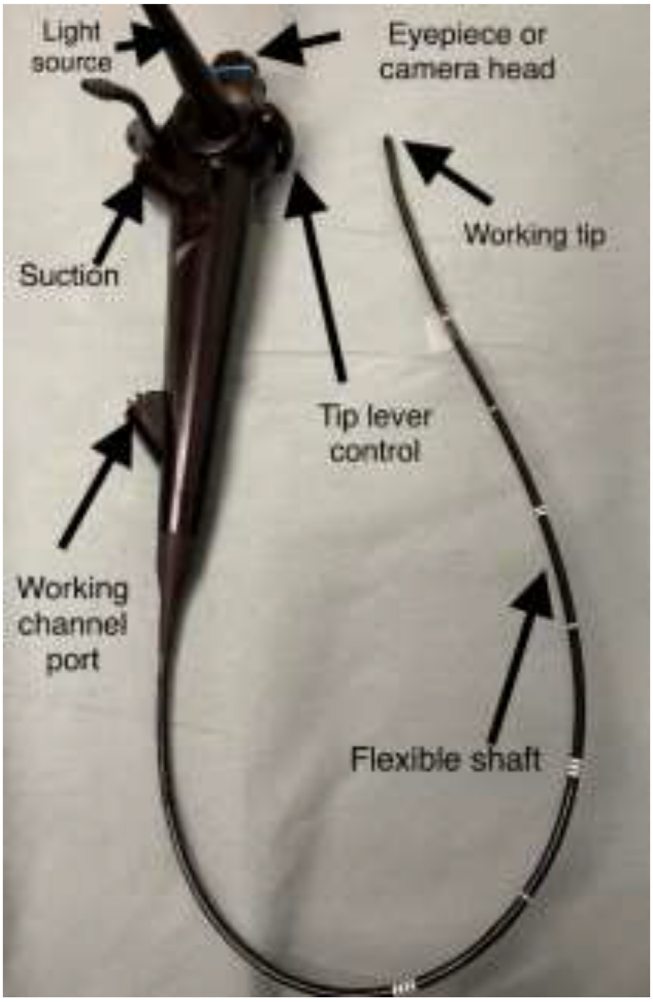

Fig. 5. Scope.

- A flexible shaft

1.2.7.1. Adult patients. Adult intubating bronchoscopes are 60 cm in length and have a diameter of either 3.7–5.5 mm, the average diameter being the smaller 4 mm scope or the larger 5 mm scope. The working channel is generally 1.2–2 mm. The smallest tube that can be accomidated by a 4 mm scope is a size 5 ID TT. A 5 mm scope can accomidate a 5.5 ID TT [28].

1.2.7.2. Pediatric patients. Pediatric scopes are either 2.2 mm in diameter and can accomidate a 3 mm ID TT or 3.1 mm which can accomidate a 4 mm ID TT.

1.3. Oral airways, bite blocks and tooth guards (Fig. 6)

A variety of specialized oral airways exist to assist with FOI. The oral airways help with the relief of obstruction, provide a midline path for the fiberoptic scope and act as a bite block to protect the scope from the patients teeth.

The most commonly used oral airways are the Williams, Berman, and the Ovasapian.

1.3.1. Facemask and nasal cannula

It is standard practice to deliver supplemental oxygen to a patient undergoing FOI especially if sedation is used. Often use of a nasal cannula is sufficient. If the patient has respiratory compromise, high flow nasal cannula may provide more optimal oxygenation. Specialized face masks, Procedural Oxygen Mask (POM, Pommedical LLC) exist to allow the bronchoscope to enter through the mask into the airway (Fig. 7).

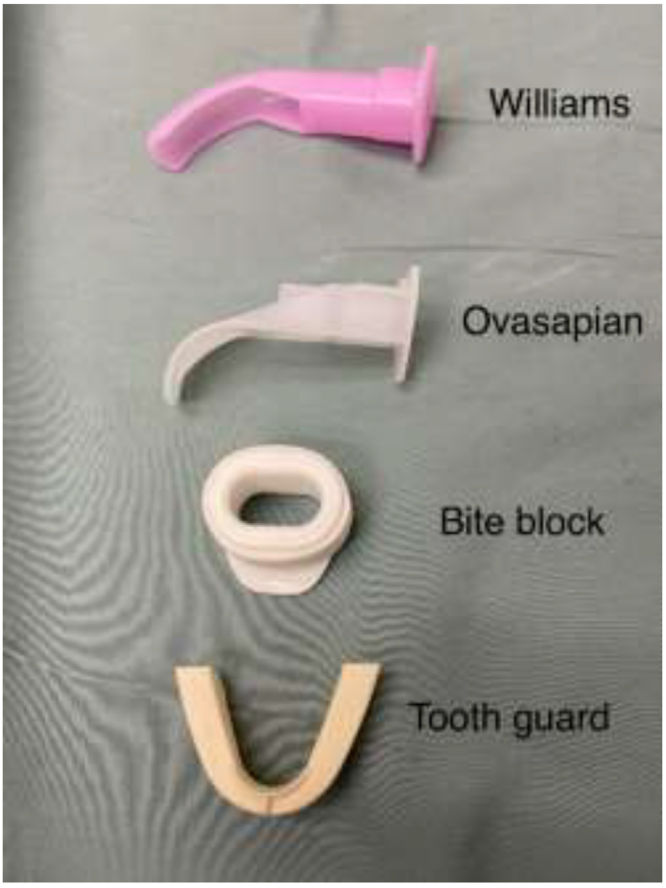

Fig. 6. Oral airways, bite blocks, and tooth guards.

1.3.2. Tracheal tubes (TTs)

Regular TTs can be used with FOI however specialized tubes exist to allow ease of passage of the tube. The Parker tube (Fig. 7) has a bull nose tip which allows ease of advancement of the tube, as the tube is less likely to get caught on the arytenoids or epiglottis [29]. TTs should be warmed and softened by placing them in a bottle of warm saline and lubricated before being used. This practice is especially advantageous for nasal intubations.

1.3.3. Antifogging agent

To minimize condensation and fogging of the fiberoptic scope, an antifogging agent is applied to the tip of the fiberoptic scope, or the tip is brought to body temperature in warm saline. This helps maintain a clear image.

1.3.4. Lubricating agent

A water-based lubricant is used to mount the TT on the fiberoptic scope and onto the TT itself to allow easy passage into the airway.

1.3.5. Nasopharyngeal airway

Nasal airways are key to facilitating a smooth nasal intubation. They may be used as a method to lubricate and dilate the nasal

Fig. 7. Tip of the Parker tube.

Fig. 8. Swivel adaptor.

passage. Gradual dilation of the nares can be accomplished by inserting nasal airways of increasingly greater diameter.

1.3.6. Vasoconstrictor agents

Vasoconstrictor agents are needed to prevent bleeding during nasal intubation. Commonly used agents are Oxymetazoline, Phenylephrine, or topical cocaine.

1.3.7. Ventilation assist device (swivel adaptor) (Fig. 8)

A swivel adaptor allows the provider to simultaneously ventilate and perform bronchoscopy on a patient. It can be used to assist with bronchoscopy in an intubated patient or intubate a patient through a supraglottic airway or mask.

1.3.8. Airway topicalization equipment

Many varieties of equipment exist to allow the application of local anesthetics to the airway. Alternatively needles and syringes of various sizes may also be used for airway nerve blocks. Topicalization equipment include:

- Atomizing devices (Fig. 9)
- Nebulizers (Mouthpiece or mask)
- Mucosal Atomization device (MADgic Wolfe Tory Medical INC, Salt Lake City, UT)
- Nasal aerosolization devices (Fig. 10)
- Lidocaine jelly
- Lidocaine/Benzocaine/Tetracaine
- Cotton pledges or cotton tipped swabs

1.3.9. Upper airway topicalization for FOI

Anesthetizing the upper airway can be achieved with either nerve blocks or topical anesthesia[30,31].

At Cleveland Clinic, a topicalization technique is commonly used for awake intubation, due to the ease of performance and lower risk of complications compared to nerve blocks. Prior to commencing topicalization it is helpful to use an antisialagogue to help dry secretions. Glycopyrrolate 0.2 mg IV is often used if there are no contraindications. This agent is best given 20–30 min prior to intubation for maximal effect.

Lidocaine is the most used local anesthetic for airway topicalization at our institution. Lidocaine is an excellent choice due to its rapid onset of action and wide therapeutic index. It comes as a liquid, gel, or ointment. The duration of action is 30–60 min, and it peaks in 15 min. Concentrations of 1% 2% and 4% are commonly used. The maximum dose allowable for topicalization is less well established. The British Thoracic Society recommend 8.2 mg/kg. Others recommend a lower limit of 4–5 mg/kg [32].

Cocaine is useful in that it has both vasoconstrictor and local anesthetic properties, thus favorable for use with nasal intubation. It is available as a 4% solution. Its maximum recommended dose for nasal application is 1.5 mg/kg. Benzocaine is available as a 10%, 15% or 20% spray. It has a rapid onset of action but is limited by the risk for the development of methemoglobinemia and its short duration of action (5 min). One should not exceed 200 mg per dose.

Vasoconstrictors used for nasal intubation include, Cocaine, Oxymetazoline 0.05%, Xylometazoline 0.1% and Phenylephrine 0.5%. Combination solutions such as Moffetts solution (epinephrine, bicarbonate, and cocaine) are not available in our institution. Our most commonly used vasoconstrictor is oxymetazoline.

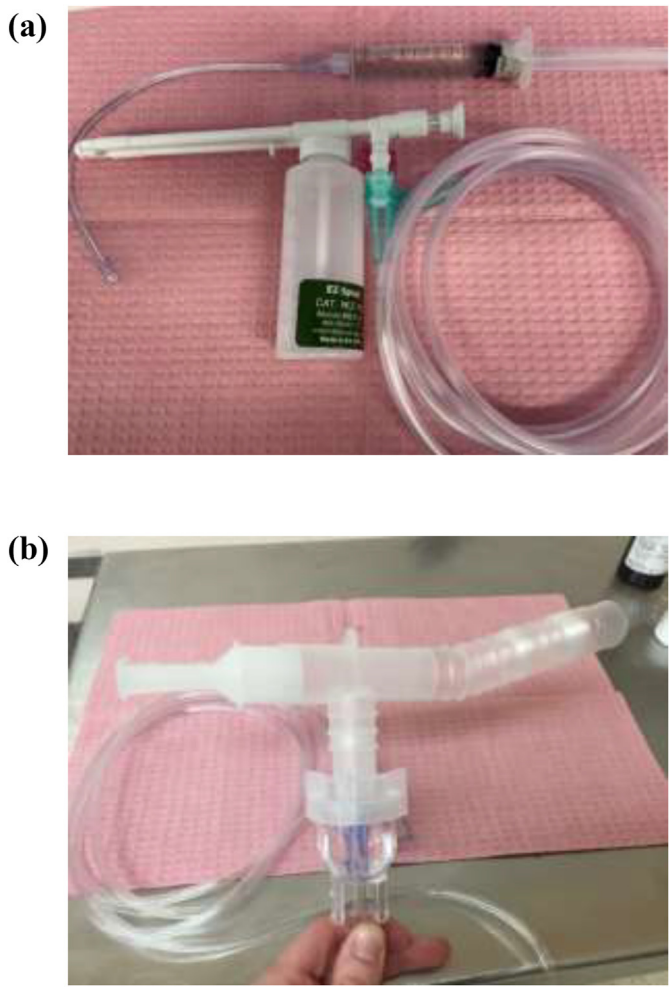

Fig. 9. a and 9b. Atomizing devices.

Fig. 10. Nasal aerosolization device.

1.3.10. Topicalization by direct application

Gargling is often used as the first step to anesthetize patient's posterior tongue, and limited portion of the hypopharynx. Five ml of 2% viscous lidocaine is placed in a disposable small cup and is given to a patient, and then he or she is instructed to gargle the solution.

Lidocaine-soaked swabs/pledges serve as local anesthetics reservoirs. They can be applied directly onto the mucosa of targeted areas. To numb the posterior pharynx, two pledges are soaked in 4% lidocaine solution and then inserted along each side of the tongue to the posterior pharynx. The pledges are left there for 5 min to block the gag reflex.

Regarding nasal intubation, one can block the *sphenopalatine ganglion and anterior ethmoid nerve* using long cotton tipped applicators. The pledges are soaked in either 4% Cocaine or 4% Lidocaine with 1:200,000 epinephrine. They are then inserted superiorly and posteriorly in the nasopharynx and left for 5 min to block the branches of the ethmoidal and trigeminal nerves.

1.3.11. Topicalization through oxygen-driven powered apparatus

1.3.11.1. Nebulizer. The mouthpiece nebulizer is commonly used for oral intubation. The face mask nebulizer can be used for both oral and or nasal intubation. The nebulizer reservoir is filled with 4% lidocaine. Administration is powered by oxygen flow of 6–8 L/min. It requires the patient to inhale the mist while breathing regularly for 15–20 min. It is best to start nebulized lidocaine early before bringing the patient into the operating room for maximal effect.

Compared to atomizer, the nebulizer can breakdown medication solution into even finer particles. It is the least invasive medication delivery method and can be tolerated well by most patients. However, due to the variable sizes of the particles delivered by the nebulizer, it is unclear whether most of the particles deposit in the upper vs lower airway by different nebulizers[32].

1.3.11.2. Atomizer. An atomizer filled with 4% lidocaine and powered by oxygen (flow rate 8–10 L/min) is used to further anesthetize the airway (Fig. 9a). The lidocaine is sprayed into the hypopharynx (Fig. 2). According to our observations, inadequate topicalization occurs occasionally. This occurs due to insufficient access to the hypopharynx, likely due to obstruction by the posterior tongue.

Once the hypopharynx is anesthetized, an oral airway is inserted. The MADGIC atomization device can then be inserted through the oral airway. The MADGIC atomization device has an atomizer nozzle attached at the end of a 6-inch malleable tubing, which can be easily bent to facilitate the spraying of lidocaine deeper into the glottis and part of subglottic area (Fig. 9b).

A small spray nozzle can be pressed against the patient's nostril and 1 ml of 4% lidocaine sprayed using a 5 ml syringe to facilitate topicalization of the nasal cavity (Fig. 10).

1.3.12. Final touch topicalization

1.3.12.1. Spray-as-you-go. It is not rare to observe that the patient's vocal cords and trachea are not sufficiently anesthetized by using atomizer or nebulizer alone. Spray-as-you-go from the fiberoptic scope is a convenient supplemental modality, which allows the provider to apply dense topical anesthesia directly to the vocal cords and subglottic area.

1.3.13. Supplemental oxygenation during FOI

The continuous administration of supplemental oxygen during FOI is recommended[7,33,34]. Desaturation is always a concern whenever sedation is given, as it is often associated with respiratory depression, especially when a patient has baseline cardiopulmonary comorbidities. Even without sedation, Woodall et al. reported the incidence of desaturation below 80% to be 1.5% among healthy volunteers undergoing FOI[12]. Topical local anesthetic itself was reported to cause total airway obstruction due to dynamic airflow limitation[35].

Routinely, conventional nasal cannula (O_2 2–6 L/min) is used. Transnasal humidified rapid-insufflation ventilator exchange

(THRIVE) high −flow nasal cannula (O_2 30−50 L/min) may also be used if the patient has significant respiratory insufficiency and is unable to tolerate the conventional nasal cannula[33].

THRIVE technique not only decreases the incidence and severity of desaturation compared to the conventional nasal cannula, but also aids the atomization and delivery of the local anesthetic through the upper airway to the trachea. This can speed up the topicalization and improve the patient's compliance[33].

The POM mask is another alternative to providing oxygen while simultaneously scoping the patient (Fig. 11).

1.4. Technique for oral and nasal awake fiberoptic intubation

1.4.1. Preparation

The technical steps of performing a FOI will vary depending on the site of the desired TT placement, either oral or nasal. Whether an TT is placed via the oral cavity or through a nasal passage, a few common considerations should be taken into account prior to the initiation of either technique.

For a patient to have a good experience during this procedure, it is important that they have a good understanding of why the procedure is being done, and what to expect. A good, honest, patient explanation of the procedure can help them navigate through the process more easily. It is also important to have equipment ready to go and induction drugs readily available. Several small steps taken prior to beginning an FOI can greatly facilitate the induction process after TT placement has been accomplished.

Prior to attempting visualization with a bronchoscope, the anesthesia machine should be checked with oxygen flowing through the circuit and the patients should be provided with supplemental oxygen. The bronchoscope should be checked to ensure that it is in working order and the tip of the scope should be defogged.

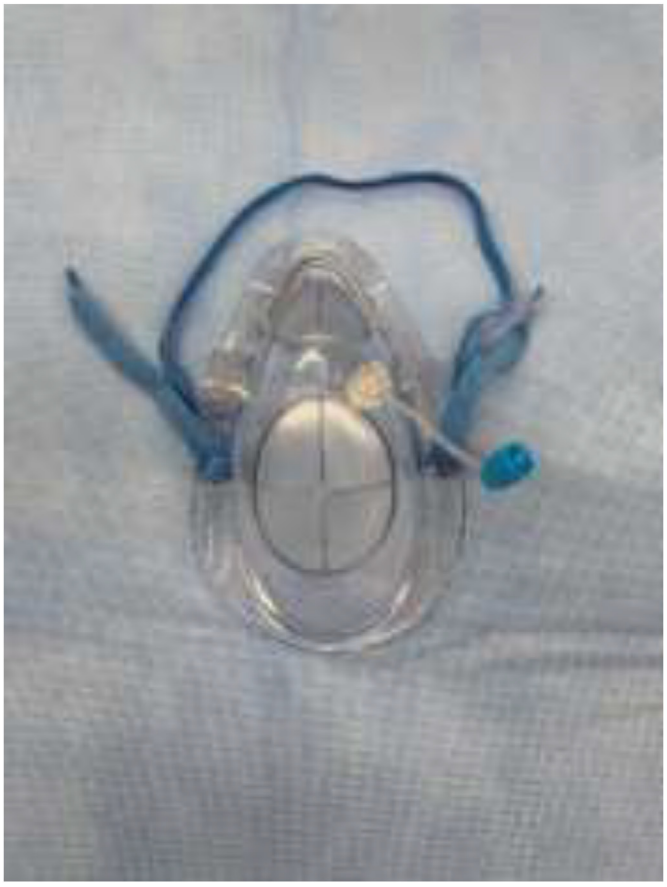

Fig. 11. Pom mask.

The size of the TT selected will be guided by the expected pathology. Generally, it is easier to pass an TT through the glottic opening if the size of the bronchoscope and the TT more closely approximate one another. When the tube is passed through the glottic aperture, if the TT fits the scope more snugly, it is less likely to get caught up on the structures surrounding the glottic aperture.

Both the bronchoscope and the cuff of the TT should be lubricated prior to loading the TT onto the bronchoscope. The suction port of the bronchoscope should be checked to ensure that it is operational and connected to suction. The syringe to be used for inflation of the cuff of the TT should be prepared and placed in an easy to reach location.

The final step in preparation relates to positioning. Oftentimes the patient will feel more comfortable if they are sitting up slightly in the bed. Not only does this facilitate patient comfort but it can also improve respiratory dynamics and help with positioning of the neck for bronchoscopy. The provider should decide if they would rather be standing at the head of the bed or along the patient's side below the shoulder for intubation. If a screen is being used, this should be placed in an area in direct line of site of the bronchoscope operator.

1.4.2. Considerations when deciding on oral versus nasal intubation

The decision of whether oral or nasal placement should be performed may be influenced by a few factors. Sometimes the surgical team will request nasal intubation to facilitate surgical technique. In other situations, oral intubation may be impossible due to anatomical issues such as trismus. Each approach is associated with its own set of advantages and disadvantages. Awake intubation via the oral route may be better tolerated by patients. With respect to tube placement, the oral route will accommodate a larger TT and requires the TT to pass a shorter distance to reach the trachea. Disadvantages to using the oral route include difficulties with advancing the tube which may be associated with the more acute angle of the pathway from the mouth to the larynx. Another is the potential for the tongue to impede visualization of the glottic opening.

Nasal intubation also has its own advantages and disadvantages. Nasal intubation can be suitable for patients with extremely limited mouth opening. As mentioned above, nasal intubation allows surgeons to perform surgery on the oral cavity without the presence of an TT acting as a hindrance. Because of its anatomical configuration, intubation may be easier through the nose since the tube follows a more of a straight line from the nasal cavity into the glottis as opposed to the acute angle it must traverse during an oral intubation. This relationship can be particularly beneficial in patients with difficult airways. For example, among patients with limited neck extension or in whom the neck is fixed in a flexed position, threading the tube over an oral inserted fiberoptic scope might be challenging due to the acute angle it has to navigate, and can lead to inadvertent displacement of the scope from the trachea. On the other hand, nasal access provides a less acute angle allowing for more anatomically favorable position for advancing the endotracheal tube over the fiberoptic scope.

Important caveats to consider with nasal intubation include patient discomfort, limitation in the size of TT that can be placed through the nares, and potential difficulties in traversing the nasal passages which can cause epistaxis. Bleeding from the nares can be difficult to control and potentially may worsen difficulties with intubation in patients with preexisting difficult airways. The correct size of tube is essential in ensuring the tube is long enough to reach

past the vocal cords, but not too large in diameter in which damage to the nasal structures may occur.

1.4.3. Technical considerations In FOI: oral approach

Once the patient has been appropriately topicalized, sedated, and the necessary equipment has been prepared, then the process of FOI may begin. Generally, the bronchoscope is held in the provider's left hand with the thumb used to depress or lift the lever thereby moving the tip of the bronchoscope. The insertion cord is held with the right hand at a distal point on the scope. Keeping the shaft in a straight line allows the provider's actions with the lever to accurately translate into the expected movement at the distal end of the scope. Thus, the right and the left hand should work in concert to smoothly move the bronchoscope directionally as a single unit.

When beginning, the bronchoscope should be inserted into the oral airway placed in the mouth. Small movements are used to keep the target in the center of the screen. The bronchoscope should be advanced through the patent passage until the epiglottis is seen. A jaw thrust may help achieve a better view and facilitate passage of the scope. Once the vocal cords are visualized, they should be placed in the center field of view. The airway may then be entered with the bronchoscope advanced into the mid trachea, approximately 3–4 cm above the carina.

Once the bronchoscope has been placed appropriately it is utilized as a stylet to advance the TT down over the scope into the airway. If the tube will not advance, gentle twisting or corkscrew motion of the tube may facilitate progression of the tube through the cords. The location of the TT is verified by capnography and bronchoscopy. Once positive capnography has been verified and bilateral chest rise appreciated, the patient may then be induced with general anesthesia.

1.4.4. Technical considerations in FOI: nasal approach

When a nasal intubation is being performed a couple of modifications are made to the above general approach. First, a decision must be made about which nares to intubate. Asking the patient whether they have an easier time breathing out of one nares compared to the other and to sniff through each nostril can be quite helpful. They should be asked about any type of known pathology or prior surgery performed on the nose.

Once a decision has been made, a vasoconstricting spray should be applied to the nares as it can help to decrease the incidence of bleeding. If desired, successive placement of increasing sizes of nasal airways lubricated with lidocaine jelly can be placed to help dilate the nasal passage. The TT should be lubricated and then held at a right angle to the face and gently passed along the floor of the nose to the nasopharynx. It is helpful to align the tube so that the writing points towards the nose. By positioning in this fashion, the bevel of the tube makes it easier for the tip to pass the epiglottis. At this point the bronchoscope can be placed within the TT and advanced until the glottic opening is visualized. Others advocate advancing the bronchoscope first followed by the TT as placement of the TT first may cause bleeding that will make visualization difficult. The bronchoscope should be advanced into the mid trachea. Subsequently, the steps outlined above should be followed for TT placement and verification of correct positioning.

1.4.5. Combined video and flexible laryngoscopic intubation

Anterior airways or airway pathology can make advancing the TT into the larynx difficult, even when using a video laryngoscope. Difficult TT advancement can cause airway trauma. Addition of a flexible scope to videolaryngoscopy can help manipulate the tube into the larynx.

Two operators are required to perform a combined technique. The first operator to hold the video laryngoscope and the second operator to drive the flexible scope [36,37]. The video screens for the flexible scope and video laryngoscope are placed side by side. This allows the flexible scope operator to easily see both screens. The 1st operator performs laryngoscopy with the video laryngoscope until clear visualization of the glottic opening is obtained on the screen. The second operator preloads the TT over the bronchoscope, and then guides the tip of the flexible scope into the oropharynx while monitoring the advancement of the scope tip on both screens. The tip of the scope is maneuvered through the vocal cords and into the trachea as with traditional flexible scope intubation. The TT is then passed over the scope and into the trachea. The operator should continue to watch the video laryngoscope screen to monitor the tube as it is advanced over the scope and into the larynx and trachea (Fig. 12A & 12B). The tube should be visualized as it passes into the glottic opening (Fig. 12C).

The combined approach may be used when the video laryngoscopic view of the glottis is poor or the angle of the glottic opening makes it difficult to direct the styletted tube into the glottis.

Advantages of the combined technique are that the double-screen view allows simultaneous visualization of the flexible bronchoscopic view of laryngeal structures and the position of flexible scope tip via the video laryngoscope screen[37].

1.4.6. Cleveland Clinic awake FOI versus DAS guidelines for awake tracheal intubation

Our practice allows more individual discretion than national or international guidelines like the DAS recommendations[7].

FOI are fairly common, so we feel comfortable doing the majority of them with a single staff. Due to the safe nature of awake intubations, if an additional set of skilled hands is required there is adequate time to request help. In regards to patient and anesthesiologist positioning, sedation and airway anesthesia we leave that up to the individual practitioner. Although high flow oxygen is available, almost all awake intubations are done with oxygen delivered via nasal cannula. One further significant difference from the DAS Guidelines is that our vasoconstrictor of choice for nasal intubations is oxymetazoline rather than phenylephrine [7,38].

2. Conclusion

We present a comprehensive report on preperation and performance for awake fiberoptic intubation as performed at the Cleveland Clinic.

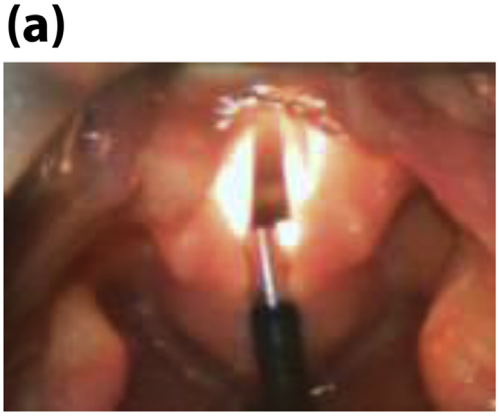

Fig. 12A. The flexible scope is placed into the interarytenoid notch. Note the acute anterior angle of the scope approaching this glottic opening.

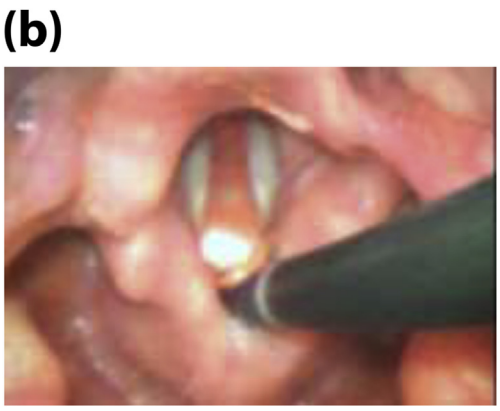

Fig. 12B. The flexible scope tip is flexed posteriorly and advanced through glottic inlet.

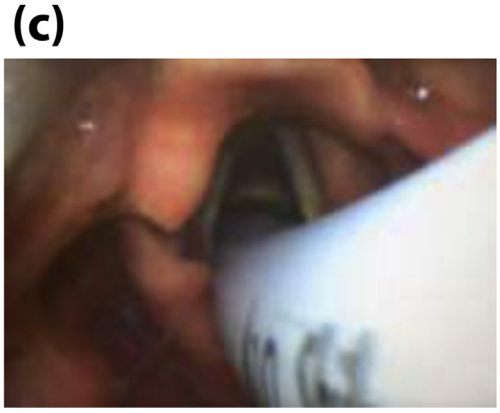

Fig. 12C. The TT can be seen advancing through the vocal cords and into the trachea.

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Ethical statement

The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Declaration of competing interest

All authors have completed the ICMJE uniform disclosure form. The authors have no conflict of interest to declare.

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