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REVIEW ARTICLE

Fiberoptic Intubation and Its Role in Management of Difficult Airway in Awake Patients

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ABSTRACT

Background There have been numerous advancements in airway equipment since the flexible fiberoptic bronchoscope was initially used. Clinicians must be aware of the functions and constraints of the equipment that is currently on the market in order to make the best decisions. Poor judgment combined with the wrong equipment selection was revealed to be a contributing factor in airway morbidity and mortality in the United Kingdom's Fourth National Audit Project. For the evaluation, diagnosis, and treatment of patients with respiratory diseases, flexible bronchoscopy (FB) is a common and safe procedure. Since Facebook was first created in 1967, its process and applications have gradually changed and grown. The fiberoptic intubation technique involves passing a tracheal tube loaded along its length through the glottis to enable for a flexible oral or nasal route that clearly visualizes the vocal cords. The endoscope is then removed once the tracheal tube has been inserted into the trachea.
Conclusions Awake fiberoptic intubation is widely advocated for the management of the known or anticipated difficult airway. However, fiberoptic intubation can be a challenging technique to learn, and continuous practice is needed to maintain the skill.
Keywords Awake intubation, Fiberoptic Intubation, difficult airway, Topicalization Technique

INTRODUCTION

Definition The phrase "difficult airway" refers to a range of conditions, from difficulties intubating and extubating a patient's trachea to difficulties in ventilating a patient's lung with a face mask or supraglottic airway [1].

We must be able to do an extensive upper airway local anesthetic block, awake look, and awake intubation (fiberoptic intubation, video assisted laryngoscope, retrograde intubation, and light wand intubation) depending on our level of competence while handling difficult intubation cases. Carried out by a minimally skilled anesthesiologist with three years' experience (justification: If this kind of an experienced anesthesiologist is struggling to visualize the glottis, then no other anesthesiologist or surgeon should try the same technique) [2]. the state of the patient and the resources available. If prone placement is required for the procedure, perform awake positioning and awake extubation.

According to a recent update to the guidelines, a difficult airway is one for which a skilled practitioner recognizes the need for an emergency surgical airway or predicts or has difficulties with facemask ventilation, tracheal intubation, or supraglottic airway usage [3].

Difficult tracheal intubation may not always be indicated by a poorly visible larynx. A different tool, like a flexible bronchoscope or a video laryngoscope, may be more successful in visualizing a larynx that is poorly visualized on direct laryngoscopy (grade 3 or 4 on the Cormack-Lehane grading scale, which grades range from 1 to 4, with higher grades indicating poorer visibility). This could then make tracheal intubation easier [4,5].

Incidence of difficult intubation

Face mask ventilation that is difficult or impossible occurs at incidence rates of 1.4-5.0% and 0.07-0.16%, respectively [6,7]. Using a traditional laryngoscope, the incidence rates of intubation difficulties and impossible are 5-8% and 0.05-0.35%, respectively [5]. Using a video laryngoscope, the success rate of intubation varies from 97.1% to 99.6% [8]. The prevalence of supraglottic airway (SGA) placement impossible varies from 0.2% to 8% [9]. Situations when one "cannot intubate, cannot oxygenate" occur between 0.0019% and 0.04% of the time [9,10].

Fiberoptic bronchoscope and its role in difficult airway

Peter Murphy [11] published the initial description of the intubating fiberoptic bronchoscope (FOB) in 1967. A success rate ranging from 88% to 100% was observed [1]. Since then, fiberoptic technology has been developed especially for tracheal intubation and bronchoscopy, and the flexible fiberoptic bronchoscope (FOB) has proven to be a vital tool in managing patients' airways while they are awake or unconscious [12].

For tracheal intubation under topical anesthetic in awake individuals, the fiberoptic bronchoscope is the suggested tool. Light waves can be transmitted, absorbed, or reflected in part. An array of optical fibers is bundled together. Ten thousand fibers, each with a diameter of 8 to 10 µm, make up a typical bundle. Coherent bundles, which are used for picture transmission, are made up of fibers that are placed precisely. The components of a fiberoptic bronchoscope (FOB) are the body, endoscope, camera, monitor, and eyepiece (Fig. 1), as well as a universal light transmitter [13].

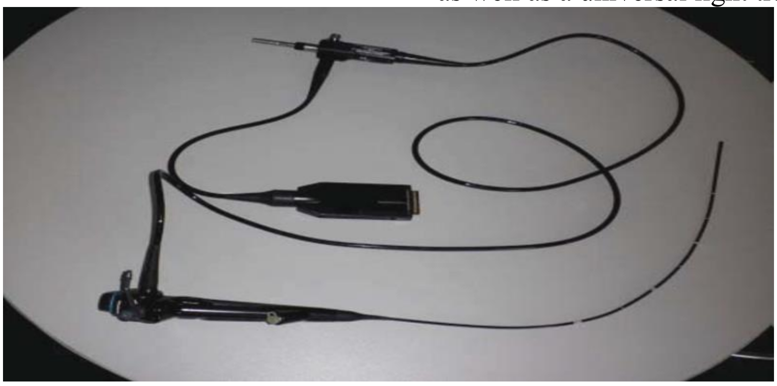

Fig. 1: The fiberoptic bronchoscope designed specifically for tracheal intubation (LF-V Tracheal Intubation Videoscope, Olympus Medical Systems Corporation, Tokyo, Japan) **[13]**.

The FOB body features a working channel that can be used for aspirating secretions or delivering oxygen or medications, a handle for moving the endoscope's tip in a vertical (up and down) plain, and an eyepiece with a knob or button for altering the image's focus. The endoscope is equipped with optic fibers that transfer images from its tip to the eyepiece or LCD screen. Additionally, it has a non-coherent bundle that transfers light from the light source to the target [13].

The FOB allows for six different movements: rotation left or right, forward or backward, and up or down in the vertical plain. Assembling the FOB forward, ante flexion beneath the epiglottis, and upward at the level of the anterior commissure is known as "up-down up," and it is the simplest FOI procedure [14]. When placing an endotracheal tube (ETT) with a diameter of at least 5 mm or a double lumen tube with a size of 37 mm or larger, a FOB with a diameter of 4.1 mm can be utilized [13].

Indications for fiberoptic intubation

When it is anticipated that airway control using direct laryngoscopy will be challenging or impossible, FOI is recommended (Table 1) [13].

Table (1): Indications for fiberoptic intubation [13].

Anticipated difficult airway in cooperative patients (based on predictive airway tests, history of difficult or failed intubation and patient characteristics, e.g., obstetrics and morbidly obese).
Unexpectedly difficult or unsuccessful intubation
Tracheal intubation in a patient with:
Limited neck range of motion

Cervical spine pathology (rheumatoid arthritis, trauma)
Upper airway edema (inhalation injury)
Mandibular or pharyngeal pathology
Tracheal pathology
Physician education (in patients with normal airway anatomy)
Physician practice for skill improvement

Contraindications to fiberoptic intubation
FOI contraindications vary depending on the situation and the anesthesiologist's level of expertise (Table 2).

Table (2): Contraindications to fiberoptic intubation [13].

1.Expected difficult mask ventilation (if a user is not familiar with)
2.Extraglottic device which can be used for ventilation)
3.Massive upper airway hemorrhage
4.Upper airway obstruction
5.Risk for regurgitation or vomiting (if a user is not familiar with the procedure for awake intubation)
6.Inexperienced anesthesiologist

Equipment for fiberoptic intubation
Table 3 lists the necessary equipment for a successful and safe FOI.

Table (3): Equipment for fiberoptic intubation [13].

Fiberoptic bronchoscope
Oropharyngeal airway: Ovassapian, Berman, Williams
nasopharyngeal airway, standard tracheal tube connector, ventilation mask
Laryngeal mask, Intubation laryngeal mask
Stylet, bougie, Magill forceps
Laryngoscope with different blade types and sizes
Two suctions: one for the fiberoptic bronchoscope and another one for oropharyngeal suctioning, suction catheters
Endotracheal tubes in different sizes, from the size 5 to the size 8
Local anesthetics
Resuscitation drugs
Lubricating gel, lidocaine gel
Ambu bag
Fixation band
Anti-fogging substance
Cricothyrotomy and tracheostomy sets
Oxygen source
Monitoring equipment (electrocardiography, pulse oximetry, noninvasive blood pressure, capnography)

Antisialagogue

Optimal local anesthetic topicalization and improved laryngoscopic visualization, particularly with the fiber optic (FOB) approach, antisialagogues such as glycopyrrolate (0.4 mg IM), scopolamine (0.4 mg IM), and atropine (0.5 mg–1 mg IM) should be administered approximately 30 to 60 minutes prior to the procedure. This will minimize oral and tracheobronchial secretions and dry the oropharyngeal secretions. Surplus secretions obstruct the local anesthetic's effectiveness. In addition to improving intubating circumstances, the absence of secretions likely reduces the amount of local anesthetic that is diluted. The antisialagogic action of glycopyrrolate lasts longer, whereas the vagolytic effect lasts for two to four hours following IV dosage. Because glycopyrrolate's quaternary amine structure impairs blood-brain barrier penetration, it has no effects on the central nervous system. Because of its pharmacologic profile, it is the recommended medication for premedicating awake intubation (AI). Apart from its strong antisialagogue qualities, scopolamine exhibits strong effects on the central nervous system, including sedation and amnesia. However, in certain patients, this can result in delirium, restlessness, and trouble waking up following brief treatments. For patients in whom tachycardia is prohibited, this medication may be the best option because it is the least vagolytic of the anticholinergics now in clinical use. the first effects appear 15 to 20 minutes after intramuscular atropine (IM) dosage. Because of its strong vagolytic actions, atropine causes considerable tachycardia despite having just a modest antisialagogic effect. It is therefore not the best medication to use to dry up the airway. It readily penetrates the blood-brain barrier as a tertiary amine and produces a slight sedative effect. Sometimes, especially in older patients, it might result in delirium [15].

Fiberoptic Techniques

The patient needs to cooperate, be understanding, and even participate in the awake service process. The patient is easiest to perform the method on while they are sitting or in a supine position. When an unobstructed surgical field is advantageous, such as in dental surgery, or when a patient has a wide tongue, limited mouth opening, retreating lower jaw, or tracheal deviation, a nasal approach is very helpful [16].

Several intubating airways or supraglottic devices can help with FOI if it is done orally. Additional methods to help with FOI include the tongue protrusion, jaw thrust, advancing the scope in the midline of the pharynx, and turning the ETT 90 degrees counterclockwise to help pass through the vocal cords in the event of resistance. There are specific face masks available that allow for mask ventilation and oxygen delivery during FOI attempts (Fig. 2, 3) [16].

Fig.2: An endoscopy mask with a specialized central orifice for placement of a fiberoptic bronchoscope. Note the additional (larger) port that can be connected to a circuit for mask ventilation [16].

Fig.3: Face mask allowing oxygen ventilation through attached double swivel connector during trail of endoscopy.

Sedation used for awake intubation

Sedation techniques

While there are other sedative options available for awake FOI, you can employ any one of the following three methods.

Midazolam and Fentanyl The method that is employed the most is this one. To get the right amount of sedation, these medications are carefully titrated. To produce the appropriate degree of anxiolysis, doses of the benzodiazepine midazolam typically range from 0.5 mg to 1 mg. 17). Fentanyl is a narcotic that acts as an airway reflex inhibitor, analgesic, and antitussive (18). Doses ranging from 25µg to 50µg of fentanyl are given. When administering awake FOI, the two medications are titrated so that the patient is conscious, breathing, and agreeable with the practitioner [19].

Dexmedetomidine It produces minor respiratory depression, reduces salivary secretion, and provides anxiolysis and analgesia [20]. The most typical method is to begin anesthetizing the patient's airway during the administration of the 1 μg/kg IV loading dosage, which usually takes 10 to 20 minutes. Following the administration of the bolus, the infusion is started at 0.7 μg/kg/hr [21].

Remifentanil Potent and short-acting, easily titratable, remifentanil is a powerful drug. It reduces airway reflexes, produces strong analgesia, and has little effect on cognitive function. Patients may remember the intubation because there is no amnesia as with the other procedures [17]. When the airway is being anesthetized, the continuous infusion is initiated at 0.075 μg/kg/min to 0.15 μg/kg/min. The patient has attained a stable condition by the time they are prepared for intubation [19].

Topical anesthesia of the upper airway

Adults should only receive a maximum of 8.2 mg/kg of lignocaine (lidocaine) (or 29 ml of a 2% solution for a patient weighing 70 kg), with special consideration for the elderly or those with liver or heart problems [22].

The most often utilized substances for topical airway anesthetic are cocaine and lidocaine. While awake intubation combined with airway topicalization is thought to be the safest technique for managing a patient's airway in a difficult-to-airway (DA) patient, there are risks involved. Ecstasy, vertigo, tinnitus, disorientation, and a metallic aftertaste are some of the initial signs of local anesthetic poisoning. Seizures, respiratory failure, loss of consciousness, and circulatory collapse are indicators of severe local anesthetic poisoning [15]. One of the following methods can be used for topicalization: directly applying the local anesthetic to the mucosa of the upper airways, or using the nebulization, atomization, and spray as you go procedures.

Prototype supraglottic topical anesthesia device

The nasal, naso pharyngeal, and oropharyngeal mucosa are anesthetized using a prototype supraglottic topical anesthesia (SGTA) device under direct administration procedures (Patency no. 23733, Academy of Scientific Research and Technology, ARST, Egypt). With a closed distal tip that allows injection of local anesthetic (LA) through the catheter's proximal aperture, the device (Fig. 4) is made up of a cotton gauze that surrounds a perforated suction catheter (15–17 cm along its distal part in adult cases). The catheter's size, which is typically 14–16 G for adults, and the length of the cotton gauze around it are determined by the patient's age and body type. With the aid of two nasal puffs of xylocaine spray at the beginning of nasal insertion, the lubricated device would ensure intimate contact between soaked cotton with LA lidocaine 1%/epinephrine 1/200 000 mixture and upper airway mucosal surface after a smooth and gradual nasal insertion through the wider nostril till the hypopharynx. The device also has the ability to re-inject LA if necessary to intensify the LA blockade. Otherwise, 5 cc of a xylocaine/epinephrine mixture would be injected through the catheter of the inserted SGTA device. The in, out, and rotator motions of the SGTA device (3–5 min after insertion) without causing discomfort to the patient demonstrated the effectiveness of SGTA [23].

Regional anesthesia of the upper airway

For upper airway anesthesia, three blocks are used: trans laryngeal block for the larynx and trachea below the cords, superior laryngeal block for the larynx above the cords, and glossopharyngeal block for the oropharynx [24].

The upper portion of the epiglottis, the oropharynx, the posterior section of the tongue, and the soft palate are all innervated by the glossopharyngeal nerve. The patient is put in a semireclined position with the clinician facing them on the ipsilateral side of the nerve that has to be blocked, following appropriate topicalization of the oropharynx. Widen the patient's mouth and move the depressors caudad and medially, one tongue at a time, exposing the tonsillar bed, uvula, palatoglossal arch, and palatopharyngeal arc. A 22-gauge, 9-cm spinal needle should be inserted into the caudad region of the posterior tonsillar pillar, with the distal 1 cm of the needle bent submucosally at a 90-degree angle. 5 mL of 0.5% to 1% lidocaine is slowly administered following negative blood aspiration; the process is then repeated on the opposite side [15].

For an external or superior laryngeal nerve block, arrange the patient supine with their head slightly extended, and have the clinician stand on the side that has to be blocked. Deep palpation is a useful tool for identifying the hyoid bone and the superior horn of the thyroid cartilage. Patients with thick or short necks may find this challenging to palpate. We can use the thyroid notch, the superior horn of the thyroid cartilage, or the greater horn of the hyoid bone as landmarks when using the external block technique. The thyroid cartilage is positioned above the hyoid bone. Deep palpation is used to identify it; this can be challenging and uncomfortable for patients with thick or short necks. (Fig. 5) [15].

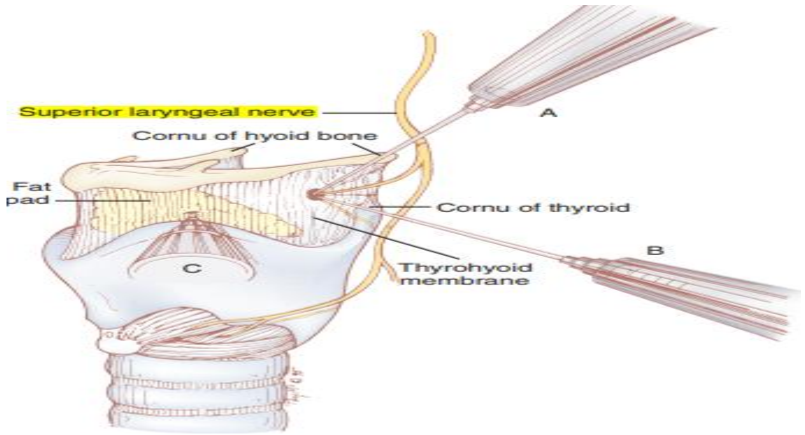

Fig.5: Superior laryngeal nerve block, external approach using as a landmark the greater horn of the hyoid bone **(A),** the superior horn of the thyroid cartilage.

The cricothyroid topical anesthetic, also known as a transtracheal block, numbs the tracheal mucosa that receives sensation from the recurrent laryngeal nerve (RLN), which supplies the trachea below the vocal cords. During a trans laryngeal block, 3 to 5 mL of 2% to 4% lidocaine are injected with a needle that goes through the cricothyroid membrane. The tracheal mucosa and the voice cords' top and lower surfaces are blocked by coughing, which also helps to nebulize the local anesthetic for greater dispersion [15]. Even so, it is still preferable to use an IV cannula G 18–20 rather of a needle, which is more painful, and to leave the plastic portion in place, which is less painful, even though it is still necessary to administer more local anesthetic for more intensive topicalization if necessary and in cases where awake extubation is difficult to achieve intubation.

However, trans laryngeal blocks are rarely utilized due to concerns about consequences including hemorrhage, subcutaneous emphysema, and tracheal damage. Thirteen. In order to become familiar with the cricothyroid topical anesthesia technique, it is still preferable to practice it alongside the spray method in a cold environment rather than performing it for the first time in a heated emergency situation where the patient cannot be oxygenated and requires jet ventilation or a cricothyroidotomy approach.

Walk off a 25-gauge needle in an anterior-inferior direction, aiming for the middle of the thyrohyoid membrane, after recognizing the larger horn of the hyoid and gently moving it to the side to be blocked. Upon passing through the membrane, the needle normally encounters a minor resistance as it reaches the preepiglottic area, which is typically 2 to 3 mm deep to reach the hyoid bone. As the needle is being removed, inject 2 to 3 mL of local anesthetic (1% to 2% lidocaine) into the adjacent carotid artery. Repeat on the other side to achieve adequate sensory blocking in 5 minutes. This procedure should be performed after negative air and blood aspiration [15].

Vasoconstrictor and local anesthetic administration in the nasopharynx are also required if the nasal route is utilized for FOI. Standard monitoring is required during FOI, however according on the patient's state and comorbidities, additional monitoring can be required. The patient may be in a supine, semi-supine, or seated position during FOI. In rare instances where immediate intubation is required, FOB can also be utilized with the patient in the prone or lateral decubitus position [25]. In such circumstances, it may be required to elevate the chin, push on the jaw, or pull on the tongue in order to make the vocal cords easier to see [15].

Nasal instrumentation and nasal intubation for difficult airway case please for safety consider the following points:

IV sedation to keep the patient sedated but cooperative as well. Antisialagogue IM one hour before operation. No contraindication for nasal instrumentation (e.g., no fracture base, no bleeding tendency). Select appropriately smaller ETT size, i.e., smaller one size than appropriate size for his age and body habit. In general, we can use down to 6 or 6.5 size for adult case. With patient's help, select the wider patient's nostril and appropriate to the surgeon. Ask the patient to take deep maximum inspiration then to expire through only one opened nostril with the other side closed and compare with other side to find the wider nostril. After testing for effective nasal or oral topical anesthesia applied, start the technique of intubation awake you prefer. Local anesthetic / decongestant mixture applied or sprayed to the highly vascular selected nostril down to the nasopharyngeal mucosa. Adequate vasoconstriction is essential because bleeding can make visualization of the larynx extremely difficult. Prepare longitudinally split nasopharyngeal airway (being soft non traumatic). With unavailable NPA or small soft endotracheal tube, we can use warmed (even boiled) small endotracheal tube. The split nasopharyngeal airway will help as LA nasal topicalizing tool and to pass the FOB through it into front of the larynx, for easier FOB laryngeal visualization [**26**].

Extubation after FOI

The recovery of protective airway reflexes, sufficient spontaneous respiration, lack of severe airway edema, and hemodynamic stability are the requirements for tracheal extubation. But in case an airway emergency arises during the extubation of a patient with a challenging airway, the FOB should be close at hand. In the event that reintubation is required, placing an endotracheal tube exchanger through the ETT and leaving it in place for a while after extubation can be quite beneficial **[13].** Extubating patients while they are awake is standard procedure for handling challenging intubation circumstances.

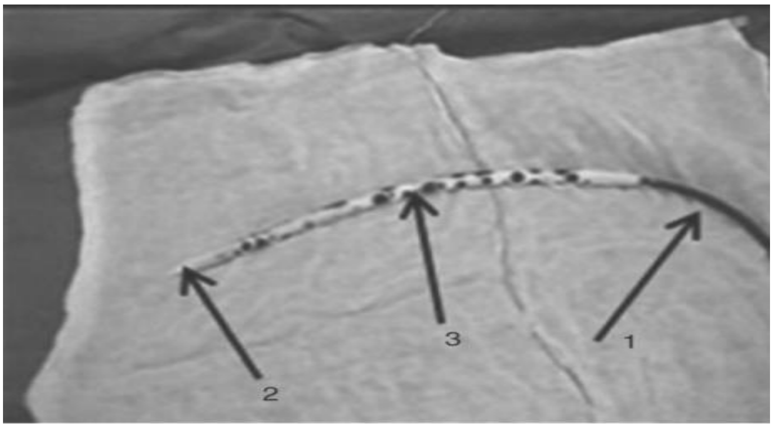

Fig.4: SGTA (1) device in the form of suction catheter injected with coloured solution representing LA. The tip of the catheter is closed (2) and its nearby distal part is punctured for a distance of 15–17 cm. The tip and the punctured parts of the catheter (3) are wrapped by the cotton gauze that will be soaked (coloured patches) with the injected solution **[23].**

FOB maintenance

Because FOI endoscopes can spread infection, it is important to carefully clean them after every usage. 99.9% of germs can be successfully removed from a FOB by washing it properly with water and a special brush. The most common chemical used to eliminate and sterilize spores is glutaraldehyde. A FOB can be stored in packaging designed for that purpose or in a straight hanging posture after being properly sterilized [**13**].

CONCLUSION

Awake fiberoptic intubation is widely advocated for the management of the known or anticipated difficult airway. However, fiberoptic intubation can be a challenging technique to learn, and continuous practice is needed to maintain the skill. Additionally, there are risks associated with this procedure, including nasal bleeding, over-sedation, airway hyper-reactivity and complete airway obstruction. The technique also requires adequate equipment and patient preparation and usually takes a considerable amount of time to be performed. All these factors have led to the underuse of fiberoptic intubation by many anesthetists.

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