NEW TECHNIQUES AND DEVICES FOR DIFFICULT AIRWAY MANAGEMENT

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SUMMARY – The purpose of this review is to compare old conventional techniques and devices for difficult airway management and new sophisticated techniques and devices. Recent techniques and devices are defined as the American Society of Anesthesiology (ASA) practice guidelines for the management of difficult airway, published in 1992, reviewed in 1993 and updated in 2003. According to ASA, the techniques for difficult airway management are divided into techniques for difficult intubation and techniques for difficult ventilation. Awake fiberoptic intubation is the technique of choice for difficult airway management prescribed by the World Health Organization document for patient safety in the operating theater. Conventional techniques for intubation used direct visualization. The new generation of devices does not require direct visualization of the vocal cords for endotracheal tube placement. They allow better glottis view and successful endotracheal placement of the tube with indirect laryngoscopy. New intubation devices such as video laryngoscopes facilitate endotracheal intubation by indirect visualization of glottis structures without aligning the oral, pharyngeal and laryngeal axes in patients with cervical spine abnormality. Video laryngoscopes such as V-Mac and C-Mac, Glide scope, McGrath, Airway Scope, Airtraq, Bonfils and Bullard laryngoscope are widely available at the market. Airway gadgets are lighted stylets and endotracheal tube guides. The principal conclusion of this review is that utilization of these devices can be easily learned. The technique of indirect laryngoscopy is currently used for managing difficult airway in the operating room as well as for securing the airway in daily anesthesia routine.

Key words: *Difficult airway management; Techniques, devices, gadgets*

Introduction

Speaking about new techniques for difficult airway management, we have to mention the old techniques, defined as the American Society of Anesthesiology (ASA) practice guidelines for the management of difficult airway, published for the first time in 1992, reviewed in 1993[1] and updated in 2003[2]. It is a systematically developed set of recommendations based on analyses of current literature and a synthesis of expert opinions. This document is a cornerstone in examining an appropriate standard of care. Every national society has defined its own guidelines for difficult airway management[3-10].

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Techniques for Difficult Airway Management

Techniques for difficult intubation:

- Alternative laryngoscope blades
- Awake intubation
- Blind intubation (oral or nasal)
- Fiberoptic intubation
- Intubation stylet-tube changer
- Laryngeal mask airway as an intubation conduit
- Light wand
- Retrograde intubation
- Surgical airway access

A combination of these techniques may be employed.

If the ability to ventilate by mask is lost, and the patient cannot be intubated (CICV scenario[11]), a truly emergent imminent brain and life threatening situation exists and gas exchange must be restored immediately[12-14].

Techniques for difficult ventilation:

- Esophageal-tracheal Combitube (ETC)
- Intratracheal jet stylet
- Laryngeal mask airway (LMA)
- Oral or nasopharyngeal airways
- Rigid ventilating bronchoscope
- Surgical airway access
- Transtracheal jet ventilation
- Two-person mask ventilation

ETC and LMA are supraglottic devices and may not allow successful ventilation if airway obstruction occurs at or below the glottis opening[15].

Awake Intubation

When management of the airway is expected to be difficult, it is logical to secure the airway[16-18]. For successful awake endotracheal intubation, it is essential to prepare the patient properly[19-23].

The components for awake intubation are[24]:

- psychological preparation (patient needs to know and agree with the procedure)
- appropriate monitoring (ECG, NIBP, SpO2, capnography)
- administration of a drying agent
- judicious sedation (keeping the patient in meaningful contact with the environment)
- induction of vasoconstriction of the nasal mucous membranes
- topical application of local anesthetic
- performance of laryngeal nerve blocks
- aspiration prevention
- availability of appropriate airway equipment
- oxygen supplementation.

Fiberoptic intubation is a technique prescribed in the World Health Organization document for patient safety in the operating theater. It has traditionally been the gold standard for the management of difficult airway.

Awake fiberoptic intubation protocol in a tertiary hospital in Spain (19AP6-6) consists of the following: information on preoperative visit; personnel: 2 anesthesiologists, 1 nurse; nasal O_2 supplementation; basic monitoring (ECG, heart rate, MAP, SpO_2), capnography and Ramsay sedation scale; drugs: atropine, midazolam and remifentanil TCI (3 ng/mL); local anesthetics for posterior pharynx: spray lidocaine 2% solution (1 mL through the fiberoptic channel at 3 levels: epiglottis, glottis, inside the trachea). The authors of this protocol conclude that the protocol is safe at 3 aspects: patient oxygenation, hemodynamic stability, and no aspiration in risk patients.

Anesthesiologists that have dexmedetomidine in the operating theater compare dexmedetomidine and remifentanil for sedation during awake fiberoptic intubations.

The Aintree Intubation Catheter is a boogie tube designed for use with a fiberoptic bronchoscope (FOB) to facilitate endotracheal intubation through the LMA, if there is a situation of unanticipated difficult intubation.

New Devices for Difficult Airway Management

There is no perfect intubation device designed yet. Everybody involved in airway management should be familiar with several different devices and/or techniques because if a difficult airway problem appears, it has to be managed safely.

New intubation devices for difficult airway treatment are video laryngoscopes[25,26]. Video laryngoscopes provide an indirect view of the upper airway[27]. They facilitate endotracheal intubation by indirect visualization of glottis structures through optical systems.

Indirect laryngoscopy is performed without aligning the oral, pharyngeal and laryngeal axes, making the device ideal for patients with cervical spine abnormality.

Video laryngoscopes such as V-Mac and C-Mac, Glide scope, McGrath, Airway Scope, Airtraq, Bonfils and Bullard laryngoscope are widely available on the market.

In contrast to conventional direct laryngoscopy, the new generation of devices does not require direct visualization of the vocal cords for endotracheal tube (ET) placement. These devices allow better glottis view and successful endotracheal placement of the tube, especially if direct laryngoscopy is difficult.

Some authors conclude that the Airtraq laryngoscope is easier to use but it does not have any significant advantages compared with the Macintosh laryngoscope for routine airway management. More studies are needed to evaluate its use in patients with difficult airway, and in emergency procedures.

In difficult airway management, video laryngoscopes improve Cormack-Lehane grade and achieve the same or higher intubation success rate in less time, compared with direct laryngoscopes. Despite the very good visualization of the glottis, the insertion and advancement of the ET with video laryngoscopes may occasionally fail. Each particular device's features may offer advantages or disadvantages, depending on the situation the anesthesiologist has to deal with. So far, there is inconclusive evidence indicating that video laryngoscopy should replace direct laryngoscopy in patients with normal or difficult airways.

The Bullard laryngoscope and the intubation laryngeal mask (ILMA) are useful equipment in intubation patients with limitation of cervical movements. Although not statistically significant, the Bullard laryngoscope may provide a higher success rate of intubation when compared with the ILMA[28].

The Bullard and Upsher fiberoptic laryngoscopes, the WuScope system and the Augustine scope have several features in common, including an anatomically shaped blade, fiberoptic bundles and a light source. They should be inserted in midline, the anatomically shaped blade does not require head motion for insertion, they can be used to facilitate nasotracheal intubation (except for Augustine scope and Upsher scope) and a video camera can be attached to the eyepiece for teaching purposes. All of them may be used in awake or anesthetized patient.

The Bullard laryngoscope has some references that could be useful to know. The larynx is well visualized because the fiberoptic bundle, located on the posterior aspect of the blade comes to within 26 mm of the distal tip of the blade. A 3.7-mm channel with a Luer-Lock connection can be used for suction, oxygen insufflation or administration of local anesthetics during laryngoscopy. A three-way stopcock allows for accommodation of more than one option. There is a lumen that allows passage of the 4-mm flexible fiberoptic bronchoscope or other guide device to facilitate intubation. The stylet is attached to the body of the Bullard laryngoscope with a finger screw. The thin laryngoscope blade allows insertion of the device into the patient's mouth with minimal (0.64 cm) mouth opening. Six methods of intubation have been described using this laryngoscope: ET with a malleable stylet, an ET exchanger, an ET with movable tip, the Bullard intubation forceps and the two intubation stylets. The most commonly employed techniques involve the use of intubation stylets.

During intubation with the Bullard laryngoscope, the use of the Parker Flex-Tip tube is associated with more rapid success and a lower incidence of re-direction of the Bullard laryngoscope during endotracheal intubation when compared to a standard endotracheal tube[29].

However, there are literature data indicating that the video-optical intubation stylet was a more effective and simpler intubation device to facilitate difficult tracheal intubation than the Bullard laryngoscope.

Airway Gadgets

Lighted stylets

In 1957, Macintosh and Richards were the first to describe intubation of the trachea under direct vision, using a lighted introducer to guide the ET through the cords. The first transillumination technique to guide nasotracheal intubation was described 2 years later.

Transllumination techniques rely on transillumination of the tissues of the anterior neck to demonstrate the location of the tip of the ET. A well-circumscribed glow visible in the anterior neck indicates tracheal location, whereas a diffuse glow is seen with esophageal intubation.

In the last several years, a number of commercial transillumination products have been developed, including the disposable Flexion and Tube Stat Lighted Stylet; the partially disposable Trachlight, Imagica Fiberoptic lighted stylet and Vital light; and no disposable versions, the fiberoptic lighted intubation stylet and the Shuttle, Fiber light view lighted stylet, the latter being available in both adult and pediatric sizes, allowing for its use in ET as small as 4.0 mm inner diameter (ID). These products have been used effectively for both orotracheal and nasotracheal intubations.

Trachlight (Trachlite, Surch-lite, "Light wand") comprises three parts: reusable handle, a disposable flexible wand and a stylet. The stylet attaches to the

handle by a ratchet-like mechanism and its position on the handle may be adjusted; thus, ET of varied lengths can be accommodated. The stylets are now available in three sizes: infant, child and adult. A clamp of the distal end of the handle locks the ET into place.

Endotracheal tube guides:

1. Eschamann introducer: a gum elastic boogie, 60 cm long, 15 Fr-gauge stylet angled 40 degrees at the distal end;
2. Patil two-part intubation catheter, 63 cm long, 6 mm in diameter, with adapter for oxygenation of the patient until permanent airway has been established;
3. Augustine guide, for blind intubation in adults;
4. Air guide inflatable introducer, soft stylet 30-45 cm long, 3 mm in diameter, with air-inflatable balloon at the end (bubble-tip) and self-closing valve at the other end.

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Sažetak

NOVE TEHNIKE I UREĐAJI ZA OBRADU POTEŠKOĆA U DISANJU

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Cilj ovog osvrta je usporediti stare konvencionalne tehnike i uređaje za obradu poteškoća u disanju i nove sofisticirane tehnike i uređaje. Dosadašnje tehnike i uređaje propisala je ASA (Američko udruženje anesteziologa) kao praktične smjernice u obradi poteškoća u disanju, iste su objavljene 1992., revidirane 1993. i ažurirane 2003. godine. Prema ASA tehnike za obradu poteškoća u disanju podijeljene su na tehnike za poteškoće pri intubaciji i poteškoće pri ventilaciji. Budna fiberoptička intubacija kao tehnika izbora u obradi poteškoća u disanju propisana je dokumentom Svjetske zdravstvene organizacije o sigurnosti bolesnika u operacijskoj dvorani. Konvencionalne tehnike intubacije koriste direktnu vizualizaciju. Nova generacija uređaja ne zahtijeva direktnu vizualizaciju glasnih žica pri postavljanju endotrahealnog tubusa. Oni omogućavaju bolju vizualizaciju i uspješnu endotrahealnu intubaciju putem indirektne laringoskopije. Novi uređaji za intubaciju, kao video laringoskop, olakšavaju endotrahealnu intubaciju indirektnom vizualizacijom struktura grla bez premještanja oralne, faringealne i laringealne osi bolesnika s abnormalnostima vratne kralježnice. Video laringoskopi kao V-Mac i C-Mac, Glide skop, McGrath, Airway skop, Aertracq, Bonfils i Bullard lako su dostupni na tržištu. Naprave za disanje su svjetleće sonde i endotrahealni vodiči (ili vodiči endotrahealnog tubusa). Zaključak ovog osvrta je da se primjena ovih uređaja može lako naučiti. Tehnika indirektne laringoskopije već se koristi u obradi poteškoća u disanju, kao i u svakodnevnoj anesteziološkoj praksi.

Ključne riječi: *Obrada poteškoća u disanju; Tehnike, uređaji, naprave*