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REVIEW ARTICLE

Extubating Techniques for the Difficult Airway

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Objectives

1. To review current guidelines describing approaches to extubating the difficult airway

2. To review the practical technique for using an airway exchange catheter

Keywords

1. Reintubation in the Post Anesthesia Care Unit (PACU) or Intensive Care Unit (ICU) are not uncommon events

2. It is often possible to predict certain patients who may be difficult to reintubate

3. Guidelines exist to guide clinicians in their decision making, preparation and techniques for extubating the difficult airway

4. An airway exchange catheter is the most widely accepted tool to assist in extubating the difficult airway

Introduction

PACU or ICU patients generally require reintubation for two main reasons-inadequate airway patency (extubation failure) and residual need for mechanical support (weaning failure). Such events are relatively common and can be associated with significant morbidity, mortality and costs [1]. However, while the majority of reintubations are relatively straightforward, certain patients may be difficult to reintubate either from pre-existing conditions or from reasons related to their need for critical care. Risk factors for difficult reintubation include: known difficult airway, obstructive sleep apnea, major head and neck surgery, cervical spine surgery, and the obstetrics population [1,2]. It would therefore be beneficial for anesthesiologists or critical care physicians to develop strategies and tools to guide their decision making and actions as they consider extubation of the difficult airway.

Difficult Extubation Guidelines

The first published guidelines for difficult airway management were written by the American Society of Anesthesiologists (ASA) in 1993 and focused on difficult airway *intubation* [3]. Only recently has greater attention has been directed towards *extubation* of the difficult airway. While the 1993 ASA guidelines, updated in 2003 [4] and 2013 [5], made general recommendations for extubation of the difficult airway, the Difficult Airway Society (DAS) has published specific algorithms concerning the management of tracheal extubations [6]. More recently, research on difficult airway extubation and extubation failure has been summarized in a comprehensive review [1].

DAS Guidelines for Management of Tracheal Extubation

The DAS guidelines describe a basic extubation algorithm consisting of four steps [6]:

1. Plan extubation.
2. Prepare for extubation (risk stratify to at-risk or low-risk).
3. Perform extubation.
4. Post extubation care and follow up.

Step 1 consists of assessing *airway* risk factors (e.g. known difficult airway, obesity, obstructive sleep apnea)

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and *general* risk factors (e.g. cardiovascular/respiratory instability). Step 2 suggests optimizing patient factors (e.g. cardiovascular, respiratory, metabolic) and environmental factors (e.g. location, availability of skilled help, special equipment). Once conditions are optimized, Step 2 risk stratifies patients into "low risk" and "at risk" extubation groups. Step 3 provides specific algorithms for the act of extubation in these two groups. The "low risk" and "at risk" algorithms then converge to Step 4 of the basic algorithm with considerations for post extubation care (e.g. proper monitoring, provision of oxygen).

The "at risk" extubation group takes into consideration the *airway* risk factors and the *general* risk factors described in Step 1. (Here, the guidelines also remind the clinician to consider whether extubation should be performed at all, suggesting postponement and tracheostomy as alternative options). *Airway* risk factors include pre-existing airway difficulties, perioperative airway deterioration, and restricted airway access (i.e. situations where reintubation would be *difficult*). *General* risk factors include impaired respiratory function, cardiovascular instability, and neurological impairment (i.e. situations where reintubation may be *necessary*). The algorithm then specifically advocates the use of an airway exchange catheter as an "advanced technique" for extubating patients with airway risk factors.

ASA Practice Guidelines for Management of the Difficult Airway

The ASA recommendations for extubation of the difficult airway have not significantly changed since publication of the initial guidelines in 1993 [3,5]. In summary, the 2013 guidelines [5] state that a pre formulated strategy should be formed, including:

1. A consideration of the relative merits of awake extubation versus extubation before the return of consciousness.
2. An evaluation for general clinical factors that may produce an adverse impact on ventilation after the patient has been extubated.
3. The formulation of an airway management plan that can be implemented if the patient is not able to maintain adequate ventilation after extubation.
4. A consideration of the short-term use of a device that can serve as a guide for expedited reintubation.

These recommendations are very general in nature which may be explained by the origin of the ASA guidelines as a document emphasizing difficult intubations and also by the ASA's preference to expand only upon evidence based recommendations. These four points are based on a consensus of expert opinions.

In their review, Cavallone and Vannucci [1] aimed to move beyond expert opinion by elaborating on the ASA difficult extubation strategy using evidence based literature. For example, they discussed the pros and cons of awake versus asleep extubation, and they present evidence for airway edema and residual neuromuscular blockade as general clinical factors that may adversely impact the patient after extubation.

A detailed comparison between the DAS and the ASA guidelines for extubation of the difficult airway is beyond the scope of this review. However, two differences and one important similarity are worth noting. First, the ASA guidelines suggest the use of a laryngeal mask airway (LMA) as a conduit for reintubation of the difficult airway while the DAS guidelines specifically recommend against it. Second, the ASA guidelines leave open the option of deep extubation while the DAS guidelines do not.

The one common feature of both guidelines is the endorsement of an airway exchange catheter (AEC) as a device to facilitate reintubation of the difficult airway. Cavallone notes that it is the only tool that "has gained wide acceptance or has been routinely adopted in clinical algorithms" [5]. Therefore, AEC's merit further discussion.

Airway Exchange Catheter

While originally designed for simple endotracheal tube (ETT) exchanges, the use of an AEC is the most widely described and accepted technique for facilitating the reintubation of the difficult airway [6]. An AEC is a long, semi-rigid, radiopaque, polyurethane tube with side holes, a blunted tip at the distal end and an orifice at the proximal end. The Cook AEC (Cook Critical Care, Bloomington, IN) is supplied with a 15 mm connector (which can be attached to an ambu bag or anesthesia machine circuit) and a Luer lock adapter (for oxygen insufflation or jet ventilation). It is also marked in centimetres in order to measure depth of placement. The two most common sizes are the 11 Fr and 14 Fr catheters, with the 11 F being recommended for shorter adults (< 5'5") and 14 F for taller adults (> 5'5") [7].

The AEC can therefore serve three functions: conduit for routine ETT exchange, oxygenation/ventilation, and as a safety measure in cases where an airway is anticipated to be difficult to reintubate.

The technique for insertion of an AEC and reintubation over the device is well described by the DAS guidelines [6] and Cavallone's review [1] and can briefly be summarized:

Predetermination of depth

The AEC should not be inserted past the carina due to the risk of trauma and perforation of small airways potentially leading to a pneumothorax. In fact, it is best to avoid any contact with the carina to avoid the cough reflex (some authors advocate injection of lidocaine through the ETT to further mitigate this effect). It is recommended that practitioners should aim to insert the AEC to the same depth as the ETT (usually 20-22 cm orally or 27-30 cm nasally) and never more than 25 cm (DAS). If there is doubt regarding the distance to the carina, fiberoptic bronchoscopy may be performed

before insertion of the AEC to assess the distance of the ETT tip above the carina.

Insertion of AEC and removal of ETT

Lubricate the AEC and suction the oropharynx before inserting the device. Advance the AEC to the predetermined length. Remove the ETT while maintaining the position of the AEC (avoid tendency to advance AEC during withdrawal of the ETT). Tape the AEC to the patient's forehead or cheek and record the depth in the patient's chart. Label the AEC in order to distinguish it from other devices such as nasogastric tubes and include the date and time of insertion. The optimal time period for leaving an AEC in place is undetermined. Thirty to 60 minutes appears to be the minimum recommended time required to pass the period of at risk reintubation but the clinical scenario should dictate the final decision [1,7]. The 11 Fr and 14 Fr are well tolerated by patients and have been reported to be left in place for up to 72 hours [7,8].

Reintubation over AEC

The usual preparations for intubations should be taken i.e. preoxygenation, positioning, presence of skilled personnel. Drugs including topical anesthetics, sedatives and muscle relaxants should be used at the discretion of the clinician. The technique involves railroading an appropriate sized ETT (smaller is usually better because it will "hug" the AEC and therefore be more likely to follow the AEC's path and not get caught up in surrounding structures such as the arytenoids). If possible, the larynx should be visualized during the reintubation period either directly, or indirectly using a video laryngoscope [9]. In addition to allowing confirmation of ETT entry through the vocal cords, a laryngoscope will retract the tongue and thereby create more space for smooth passage of the ETT (manual jaw thrusts may also serve this purpose) [7]. As with removal of the ETT, care should be taken to maintain position of the AEC and avoid pushing it down farther. Once confident that the ETT is in the trachea (either through laryngoscopic visualization or smooth "feel" of insertion), the AEC can be removed and the desired method of oxygenation/ventilation can be applied.

Complications

Morbidity from AEC's include pneumothorax, subcutaneous emphysema, pneumoperitoneum, and hypoxia [1]. These complications are usually attributed to inappropriate positioning (direct trauma to the airways or esophagus), jet ventilation (barotrauma) and even passive oxygenation (barotrauma) [1,6,10,11]. Therefore, in addition to the precautions described above during AEC placement and reintubation, it is recommended that standard techniques for oxygenation be employed when necessary and that jet ventilation or oxygenation through the AEC only be considered in extreme circumstances [6,11]. The primary strategy for managing respiratory decompensation in patients with an indwelling AEC should be reintubation over the device [1,6,11].

Conclusions

Difficult airway management protocols in the ICU should include discussion of extubating known or potentially difficult airways. The ASA, DAS and reviews of literature have provided principles and guidelines to aid clinicians to assess, plan, and perform extubations of difficult airways. This literature should be carefully reviewed by all clinicians working in ICU's where a high incidence of such patients may exist. Technical skills such as use of video laryngoscopy and airway exchange catheters should also be practiced in these settings. Such additional training will increase patient safety during this critical process of ICU care.

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