Guidelines 4 (AIDAA)

All India Difficult Airway Association 2016 guidelines for the management of anticipated difficult extubation

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ABSTRACT

Extubation has an important role in optimal patient recovery in the perioperative period. The All India Difficult Airway Association (AIDAA) reiterates that extubation is as important as intubation and requires proper planning. AIDAA has formulated an algorithm based on the current evidence, member survey and expert opinion to incorporate all patients of difficult extubation for a successful extubation. The algorithm is not designed for a routine extubation in a normal airway without any associated comorbidity. Extubation remains an elective procedure, and hence, patient assessment including concerns related to airway needs to be done and an extubation strategy must be planned before extubation. Extubation planning would broadly be dependent on preventing reflex responses (haemodynamic and cardiovascular), presence of difficult airway at initial airway management, delayed recovery after the surgical intervention or airway difficulty due to pre-existing diseases. At times, maintaining a patent airway may become difficult either due to direct handling during initial airway management or due to surgical intervention. This also mandates a careful planning before extubation to avoid extubation failure. Certain long-standing diseases such as goitre or presence of obesity and obstructive sleep apnoea may have increased chances of airway collapse. These patients require planned extubation strategies for extubation. This would avoid airway collapse leading to airway obstruction and its sequelae. AIDAA suggests that the extubation plan would be based on assessment of the airway. Patients requiring suppression of haemodynamic responses would require awake extubation with pharmacological attenuation or extubation under deep anaesthesia using supraglottic devices as bridge. Patients with difficult airway (before surgery or after surgical intervention) or delayed recovery or difficulty due to pre-existing diseases would require step-wise approach. Oxygen supplementation should continue throughout the extubation procedure. A systematic approach as briefed in the algorithm needs to be complemented with good clinical judgement for an uneventful extubation.

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INTRODUCTION

Tracheal extubation is as important as tracheal intubation for an uneventful patient recovery.[1] Extubation is defined as purposeful removal of the tracheal tube and transition from an established airway to normal natural airway.[2] Extubation failure is defined as the inability of the patient to maintain a patent airway with effective spontaneous ventilation after purposeful removal of the previously placed endotracheal tube (ETT) within a specified time.[3] Although the incidence of extubation failure or reintubation after surgery in operation theatre (OT) is relatively uncommon with an incidence of 0.1%–0.45%, it leads to an overall increased mortality.[4] Concerns have been highlighted by different airway societies in their guidelines.[5,6] Extubation concerns have been well emphasised in the American Society of Anesthesiologists Closed Claims Analysis and National Audit Project 4 (NAP4).[1,7] The NAP4 report studied the airway-related issues and observed a mortality rate of 5% in patients with extubation failure after general anaesthesia.[7] They reported an incidence of 13% for severe outcomes after extubation failure.[7] The airway-related complications during securing the airway are reducing; however, extubation-related concerns remain unattended.[1] Some elements of these guidelines may not be well suited to the Indian scenario, and hence, extubation guidelines were formulated to suit our needs and situation. These guidelines encompass various strategies for a safe extubation, easily executable and modifiable as per the local requirements. The All India Difficult Airway Association (AIDAA) algorithm on extubation is a recommendation of the association and may be modified as per the individual need based on available equipment, expertise and individual limitations. These guidelines should be used in conjunction with 'AIDAA 2016 Guidelines for the Management of Unanticipated Difficult Tracheal Intubation in Adults.'[1]

METHODS

The methodology adopted for development of the AIDAA guidelines including anticipated difficult extubation guidelines has been explained previously.[8] A thorough literature search was done using databases/search engine (Medline, PubMed, Google Scholar, websites of National Societies for airway guidelines) till September 2016. The articles were manually searched from cross-referencing. All manuscripts and abstracts published in English were searched. The keywords used included 'difficult extubation', 'tracheal extubation', 'extubation', 'difficult airway', 'airway exchange catheter', 'AEC', 'supraglottic airway', 'tracheostomy', 'steroids', 'recovery', 'oedema', 'cardiovascular'. In addition, opinions of experts and members of the societies were taken for extubation-related concerns not having definite evidence.

EXTUBATION GUIDELINE

Extubation is an elective procedure, and hence, strategies need to be planned based on the individual patient condition. It is prudent to assess not only the airway but also other medical or surgical factors that have impact on the plan for extubation. Wherever possible, extubation conditions should be optimised. The common causes for reintubation include bronchospasm, poor respiratory efforts, airway obstruction, residual neuromuscular blockade or residual effects of drugs such as sedatives/opioids (delayed recovery).[9] Pre-existing airway concerns such as difficult mask ventilation, intubation, obesity and obstructive sleep apnoea (OSA) mandate vigilant extubation. The airway may become compromised due to perioperative manipulations (surgical procedure, oedema, collapse, multiple airway management attempts). AIDAA also recommends supplementation of 100% oxygen in 'peri-extubation' period.

The algorithm is primarily limited to difficult extubation. Routine extubation usually requires conventional extubation requirements and steps.

Extubation of normal airway without added cardiovascular or respiratory comorbidities includes as follows.

- Assessment of any potential difficult airway, neuromuscular, respiratory or cardiovascular compromise. If yes, use the difficult extubation algorithm; if no, proceed for extubation after antagonising residual neuromuscular blockade and switching off the volatile anaesthetic agent
- Assessment of the criteria for extubation
- Performance of extubation and monitor the patient
- Supplement oxygen using appropriate oxygen delivery devices. The flow, fraction of inspired oxygen and duration may be individualised as per patient requirements

Extubation strategies may be planned based on initial assessment with regards to difficulty in airway and predicted concerns in extubation. Patients requiring extubation may be broadly categorised to fit into one of three strategies (labelled as limbs) [Figure 1].

Limb 1: Extubation in normal airway requiring suppression of haemodynamic responses at extubation

Certain groups of patients who have undergone eye surgeries, vascular surgeries, intracranial surgeries or thoracic surgical procedures may require suppression of respiratory and cardiovascular reflex responses during extubation. Tracheal extubation has been associated with pressor response with 10%–30% increase in blood pressure and heart rate. The pressor response may last for 5–15 min and may not be acceptable in patients following cardiac or neurosurgery.[2,10] Coughing is also undesirable as it causes an increase in intraocular, intrathoracic and intracranial pressures in addition to increasing heart rate and blood pressure. These patients could be extubated in an awake state or under deep inhalational anaesthesia.[9] The trachea could be extubated in awake state by suppression of the responses using pharmacological agents such as topical lignocaine 10%, intravenous β-blockers (intravenous esmolol 1.5 mg/kg, 2–5 min before extubation), lignocaine 1 mg/kg over 2 min or fentanyl 0.5–1 μg/kg, dexmedetomidine 0.75 μg/kg administered 15 min before extubation.[2,11,12] The other option could be to replace the ETT with a supraglottic airway device (SAD) (preferably a second generation) under deep anaesthesia. Extubation under deep anaesthesia prevented haemodynamic and respiratory responses such as hypertension, tachycardia, dysrhythmias, coughing, laryngospasm, myocardial ischaemia and increased intracranial and intraocular pressures.[8,13,14] However, it may be associated with risk of upper airway obstruction and aspiration. To circumvent such issues, AIDAA recommends using an SAD as a bridging device. This technique should be avoided in cases of full stomach (obese, pregnant, recent ingestion of food or raised intra-abdominal pressure).[2,9] Exchange with SAD avoids any reflex response due to tracheal tube intolerance or its removal at emergence from anaesthesia.[15-18] Bailey's manoeuvre has been reported to be useful for effective exchange of ETT with laryngeal mask airway.[17] The replacement of a tracheal tube with a SAD needs to be done when the patient is still under deep anaesthesia and before antagonism of residual neuromuscular blockade. We emphasise that this is an advanced airway management technique that requires expertise and practice.

Techniques of exchanging an ETT for a SAD at emergence include as follows.[8,15-17]

- Removal of ETT and insertion of SAD blindly
- Insertion of SAD with ETT *in situ*. SAD is placed behind the ETT, and thereafter, ETT is removed
- Removal of ETT over an airway exchange catheter (AEC) and railroading the LMA through its airway lumen into the pharynx for its placement.

It is important to ensure continuous administration of 100% oxygen during the extubation process. Oral suction should preferably be performed under vision. It is important to ensure that patient does not have risk factors such as full stomach, suspected airway trauma or significant intraoperative airway manipulation. After ensuring optimal placement of SAD, residual neuromuscular blockade is antagonised and volatile agent is switched off. Once patient is fully awake, obeying commands and fulfilling extubation criteria, the SAD can be removed. All patients should be given oxygen following extubation.

Limb 2: Extubation in difficult airway including difficult mask ventilation, difficult intubation/reintubation, delayed recovery or airway difficulty due to pre-existing disease: 4 Ds

In patients in whom difficult intubation was encountered, one would be expected to have difficulty during extubation as well. These patients may be conventionally categorised as those who have difficult mask ventilation, difficult intubation or reintubation, delayed recovery or difficult/compromised airway due to pre-existing disease. These parameters may be pre-existing or may occur during the surgical procedures. Delayed recovery or depressed consciousness is a risk factor for extubation failure.[9] Pre-existing conditions such as obesity, OSA, rheumatoid arthritis, hypoventilation disorders and neuromuscular diseases may also be associated with extubation failure.[5,9] In all such situations, the difficult airway cart (components of the cart described elsewhere)[8] needs to be ready at the time of extubation, i.e., extubation should be done in a controlled environment with necessary expertise and essential equipment kept ready at the time of extubation.

During extubation in such scenarios, we ensure full recovery with regard to conscious level,

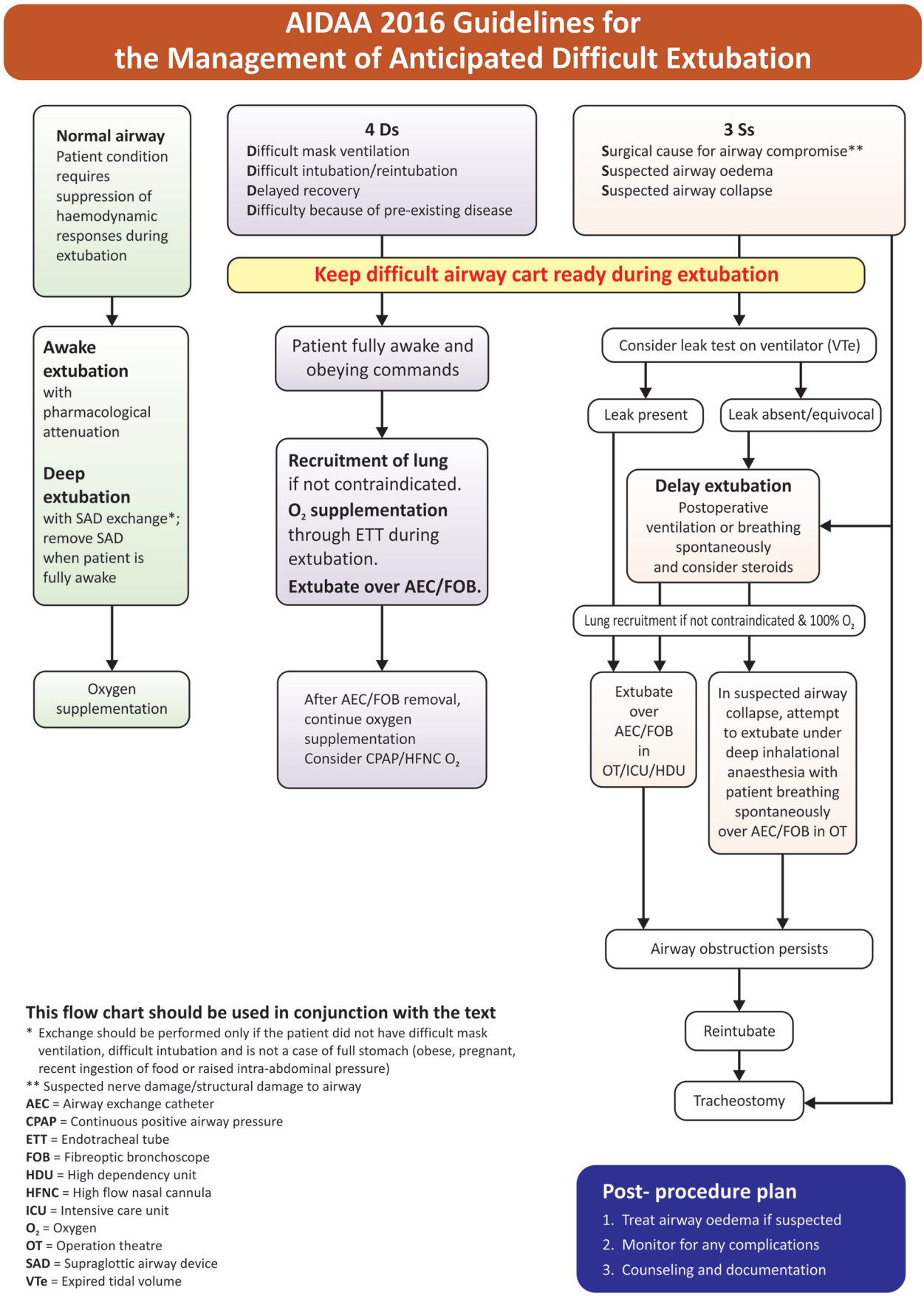

Figure 1: All India Difficult Airway Association 2016 algorithm for the management of anticipated difficult extubation

neuromuscular recovery including other extubation criteria before extubation. To increase oxygen reserves, lung recruitment should be performed if not contraindicated (as for instance following lung surgeries or in the presence of haemodynamic compromise). Oxygen supplementation should be continued through the endotracheal route during the process. Pre-oxygenation before extubation remains controversial but provides safe apnoea duration in case of airway obstruction or compromise immediately after extubation. The AIDAA recommends that all patients should receive 100% oxygen to improve oxygen reserve. Thereafter, tracheal extubation should be done over an AEC/fibre-optic bronchoscope (FOB).[18,19] Extubation using an AEC has been proposed by various national societies and there is sufficient evidence reported in literature to have good success rate of reintubation, if required.[5,6,9,15] FOB also helps in airway evaluation and if required may be used in place of AEC. All these patients should receive oxygen supplementation. If patient maintains a patent airway, AEC/FOB should be removed. The optimal timing for removal of the AEC should be individualised as a fixed timing may not work in every situation.[20] The Difficult Airway Society (UK) recommends retaining the AEC for 2 h, but the device may be kept for an extended period of up to 2 days.[5] However, if patency of airway is absent or doubtful, the ETT should be reinserted and the patient needs to be reassessed and further extubation plan formulated.

Steps for the appropriate use of AEC are as follows.

- Measure the length of AEC to be inserted ensuring the tip remains above carina. It usually corresponds to the length of the ETT *in situ* and is approximately 20–22 cm orally or 26–30 cm nasally
- After applying lubricating jelly over the AEC, insert the AEC to its appropriate depth
- Withdraw the ETT over the AEC and secure the AEC
- Continue oxygen supplementation. Oxygen (1–2 L/min) may be provided through AEC or use other techniques as described in the section of oxygenation.

Limb 3: Extubation in difficult airway due to surgical cause, airway oedema or airway collapse (3 Ss)

Patients who may have normal airway or difficult airway before the surgical intervention may become difficult or increasingly complex after the surgical procedure. Obese patients and those with OSA have increased propensity for airway collapse and thus constitute a risk factor for extubation failure.[1,9,21,22] Certain surgical procedures may lead to nerve damage which supplies the airway. In addition, surgical manipulation may lead to glottic and peri-glottic oedema. These may jeopardise the patency of the airway after the surgery and may lead to post-extubation obstruction.[9,18] Supraglottic oedema is associated with surgical handling, multiple attempts at airway management, haematoma, massive fluid infusion, decreased venous drainage and associated medical conditions such as pre-eclampsia or angioedema. Surgical procedures such as anterior cervical spine interventions, thyroidectomy, carotid endarterectomy and maxillofacial surgery may lead to airway difficulties at extubation. Multiple attempts during intubation may lead to oedema or haematoma and may cause airway obstruction at extubation. Patients may also have increased chances for airway collapse in long-standing thyroid tumours, swelling or other neck mass excision, obese patients or airway-related surgeries. In all such scenarios, the difficult airway cart needs to be kept ready at the time of extubation. In these situations, three options of extubation need to be considered.

We suggest performing a cuff-leak test before extubation to assess airway oedema or collapsibility of the airway. Although literature mentions qualitative and quantitative criteria while performing the cuff-leak test for assessment of laryngeal oedema, we recommend the quantitative test. Literature has reported a moderate accuracy for cuff-leak test for predicting post-extubation stridor and thus may be considered useful before extubation in addition to assessment of other factors responsible for oedema or collapse.[23] AIDAA recommends that a cuff-leak test is performed in patients who have a potential to develop airway oedema or collapse. This was also reiterated by a survey we conducted to get consensus among members, wherein 87% of the respondents reported the use of cuff-leak test before extubation. A quantitative cuff-leak test indicates the airway oedema or collapsibility. Cuff-leak test measures the difference in exhaled tidal volumes with the cuff inflated and deflated. This measurement should be done when the patient is still on volume control mechanical ventilation. The difference between the inflated and deflated exhaled tidal volumes is considered significant if it is <10%–25% or 110–130 mL. This is indicative of oedema or collapsibility and likely maintenance of a patent airway following extubation is a doubtful.[9,24-26]

If leak is present, trachea could be extubated over an AEC/FOB in a controlled environment such as the OT, intensive care unit or high dependency unit. To increase the oxygen reserve, lung recruitment (if not contraindicated) should be performed and 100% oxygen supplementation should be continued during the extubation process. However, if leak is absent or equivocal, then extubation should be delayed. In cases with high suspicion of airway oedema or compromise, tracheal extubation may be electively delayed. Patients can be given ventilatory support or allowed to breathe spontaneously and intravenous steroids may be considered. If used, ventilatory support needs to be continued until the airway compromise is expected to settle down. The presence of laryngeal oedema may be managed with nebulised adrenaline, head-up position and steroids.[27,28] Steroids have been beneficial in reducing inflammatory airway oedema and preventing extubation failure and may be continued for at least 12 h.[29] Intravenous hydrocortisone 100 mg three times a day is recommended. Epinephrine (1 mg epinephrine in 5 ml normal saline) can be nebulised through an additional ETT inserted in the oral cavity which is placed just above the glottis under laryngoscope guidance.[30] Patient may be reassessed at 24 h or as appropriate for airway compromise, and subsequently, extubation may be planned. Tracheal extubation is done either over an AEC or FOB. In suspected airway collapse, extubation is attempted under deep inhalational anaesthesia with the patient breathing spontaneously over AEC/FOB in OT. A patient breathing spontaneously under deep anaesthesia is likely to exert less, thereby decreasing the likelihood of airway collapse. In case of any signs suggestive of airway obstruction or compromise, the ETT should be reinserted. Further plan for surgical access such as tracheostomy should be planned as part of extubation strategy and further airway management. In certain high-risk cases where airway obstruction is inherent because of airway pathology or surgical intervention, tracheostomy may be considered early as the primary plan for extubation.

POST-EXTUBATION CARE

After extubation, patient needed to be given supplemental oxygen and monitored for any airway compromise in a controlled and monitored environment. This would help in identifying any airway compromise at the earliest as hypoxia remains a late sign for airway compromise. The NAP4 report revealed adverse outcomes after extubation in the absence of appropriate monitoring.[31] Wherever required, appropriate suctioning, heads-up positioning and bronchodilators should be continued as per patient's requirement. Difficulties experienced during extubation, management strategies used and adverse events if any need to be documented in the case notes and the airway alert form. This would help in future planning of airway management.

SUMMARY

Difficult extubation should be performed in a controlled environment with availability of equipment and expertise. It should be adequately planned and the patient condition optimised whenever possible. Although robust evidence is yet to be generated for a definite extubation plan in difficult scenarios, these guidelines will help anaesthesiologists plan an appropriate strategy based on a step-wise approach. The strategies primarily are planned based on the presence of normal airway but requiring suppression of reflex responses, presence of difficult airway, delayed recovery, pre-existing disease or airway compromise due to surgical intervention. Based on these assessments, patient may be planned an awake extubation, under deep anaesthesia or at times tracheostomy. Timing of extubation may be planned as per airway assessment such as presence of oedema. A systematic approach complemented with good clinical judgement as outlined in this guideline could result in an uneventful extubation.

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Conflicts of interest

There are no conflicts of interest.

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