Royal College of Anaesthetists

Difficult Airway Society

Tayside Mastery Learning Programme

Extubation

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LEARNING OUTCOMES

By reviewing this module, a trainee should gain an understanding of the following:

1. the ethos of tracheal extubation.
2. the principles of extubation.
3. the process of extubation.

1: ETHOS OF EXTUBATION

It is easy to underestimate the importance of extubation, and to dismiss it as just something that happens at the end of the anaesthetic. Literature, including the fourth National Audit Project (NAP4), suggests that respiratory complications are three times more common during extubation than intubation and induction. Emergence and extubation is a high-risk phase of anaesthesia and it is important for the anaesthetist to anticipate and prevent potential complications and plan to ensure patient safety at all times.[1,2] Emergence is a time of transition, where the patient will be regaining consciousness. It is also a time where we need to be cognisant of the importance of maintaining physiological stability. The focus in this regard must be on reversal of neuromuscular blocking drugs (NMBD), maintaining airway patency, avoiding hypoxia and reducing the risk of pulmonary aspiration of gastric contents. In order to achieve this – planning and preparation are key.

As with previous sections, our goal is safe extubation through the principles of:

- Airway management in the RIGHT PLACE: a suitable location with appropriate monitoring and assistance.
- Airway management with the RIGHT EQUIPMENT: using equipment with which one is familiar.
- Airway management by the RIGHT PERSON: identifying our own limitations, anticipating the need for assistance in managing predicted difficulty and recognising the need early for more expert help if unanticipated difficulty is encountered.
- Airway management with the RIGHT MIND: maintaining good situational awareness, avoiding cognitive overload and task fixation through the implementation of checklists and cognitive aids/algorithms and utilisation of good communication.

2: PRINCIPLES OF EXTUBATION

Preparation

It is important to include extubation as a part of the overall anaesthetic management plan. We will first of all consider how we prepare for extubation – this will inform our planning. Areas for consideration are the patient, the equipment required, the timing, the personnel, and the locations for extubation and for ongoing care. These interconnected factors need to be considered as a whole in making an extubation plan. In difficult or atypical scenarios, it is wise to seek senior advice and/or support.

Patient

The physiology of pre-oxygenation has been covered elsewhere in this course, but suffice to say that it is just as important at the time of emergence and extubation as it is at intubation. Sufficient pre-oxygenation gives a margin for error and a buffer against unexpected complications including airway obstruction. Therefore, it is prudent to turn up the fresh gas flows and the FiO_2 to 1.0 prior to extubation, aiming to achieve an ETO_2% of > 80.

Physiological stability is also paramount prior to emergence and extubation. This includes cardiovascular parameters being similar to pre-induction state, a normalised acid–base status and a normal core temperature. Failure to maintain this status can result in significant instability in the immediate post-operative period and may necessitate an admission to critical care.

The patient must have their neuromuscular blockade (NMB) adequately reversed. NAP5 demonstrated the increased incidence of accidental awareness under GA during emergence and extubation, and the use of NMBDs was the most significant associated risk factor. Although neuromuscular monitoring is beyond the scope of this document, it is important to know that reversal should be monitored – best practice includes the use of a quantitative neuromuscular blockade monitor such as a ToF-scan® – to ensure the return of the train of four (ToF) ratio to ≥ 0.9 prior to extubation. Evidence suggests clinical tests and timing of most recent administration of NMBD are unreliable. The dose and timing of the reversal agent should be tailored to the individual patient. It is important to include NMB management in the overall planning of extubation. The above measures will provide a high degree of airway tone, as well as adequate respiration, in the immediate post-operative period. Both will reduce the risk of post-operative pulmonary complications.

Conditions for safe extubation include physiological stability, adequate reversal from NMB, adequate respiratory drive and a return of consciousness to obey simple commands.

Consideration must also be given to the patient's positioning prior to extubation. Historically, the left-lateral head-down ('recovery') position was preferred to minimise the risk of gastric aspiration. This position is still occasionally used, more so in paediatric practice. However, many of the same advantages can be achieved with a semi-recumbent, supine position which, in the absence of vomiting, is likely to reduce the risk of passive regurgitation and contamination of the respiratory tract. Sitting the patient upright will optimise respiratory function. It also retains a familiarity for staff, safe access to the airway in a position that we are used to managing and one that patients find comfortable.

Examples of 'at-risk' extubation scenarios[3]

Airway

- Pre-existing difficulties – those identified as having difficult airway access at or prior to induction (e.g. OSA, obesity, anatomical abnormality).
- Peri-operative airway deterioration – distorted anatomy as a result of surgery, haemorrhage, haematoma, oedema, trauma, etc.

- Restricted airway access – as a result of surgery (e.g. HALO fixation, mandibular wiring, c-spine fixation).

General

- Impaired respiratory function.
- Cardiovascular instability.
- Neurological/neuromuscular impairment.
- Hypo/hyperthermia.
- Coagulopathy.
- Acid/base disturbance.
- Electrolyte derangement.

Timing and location

For reasons that should be quite apparent, the surgical procedure should be completed prior to emergence and extubation. This should be confirmed with the surgical team and it is good practice to allow the scrub staff to clean the patient and apply dressings prior to waking, in order to optimise patient comfort and dignity.

As noted previously, the patient should be physiologically stable prior to emergence and extubation. If this is not the case it is prudent to ask for senior assistance.

Extubation should be performed in a place of safety with optimal availability of equipment, drugs and expertise. Often this will be the theatre.

Personnel

Excluding exceptional circumstances, an anaesthetic assistant should be present during extubation as they would for intubation. It is often also useful to have a 'runner' present to call for further assistance in the event of a complication. A senior anaesthetist should be present for any high-risk cases and where the first anaesthetist requires assistance.

Potential complications of extubation[1]

- Airway obstruction.
- Post-obstructive pulmonary oedema.
- Hypoxia.
- Aspiration.
- Airway trauma.
- Cardiovascular disturbance.

3: PRACTICE OF EXTUBATION

Equipment

- Table/trolley capable of tipping head-down.
- Suction.
- Syringe for cuff deflation.
- Face mask.
- Spare ETT.
- Laryngoscope.
- Hudson mask and oxygen cylinder for transfer.
- Drugs to provide emergency anaesthesia.
- Anaesthetic machine/circuit capable of providing IPPV and PEEP.
- Consider the need for a bite-block.
- Monitoring including quantitative NMB monitor.

Procedure

- Prepare the patient as described above and ensure that you have all of the required equipment.
- Ensure appropriate analgesia and anti-emetic prophylaxis.
- Ensure adequate reversal of NMB (ToF ratio $\geq$ 0.9).
- Pre-oxygenate.
- Position the patient.
- Suction and clear the oro-pharynx under direct visualisation.
- If appropriate, aspirate the NG tube to empty the stomach.
- +/– insert a bite-block (e.g. rolled gauze).
- Cease delivery of anaesthetic drug (Volatile/TIVA).
- Allow patient to establish adequate respiratory pattern and depth.
- Await the patient awakening.
- Ensure that the patient obeys simple commands.
- Deflate the cuff of the ETT.
- Remove the tube while applying positive pressure to the bag of the anaesthetic circuit.
- Apply the face mask attached to breathing circuit and ensure airway patency.
- Confirm airway patency using capnography and clinical assessment.
- Titrate analgesia as required.
- Safely transfer the patient to the recovery area and hand over.
- Document any difficulties encountered during emergence/extubation.

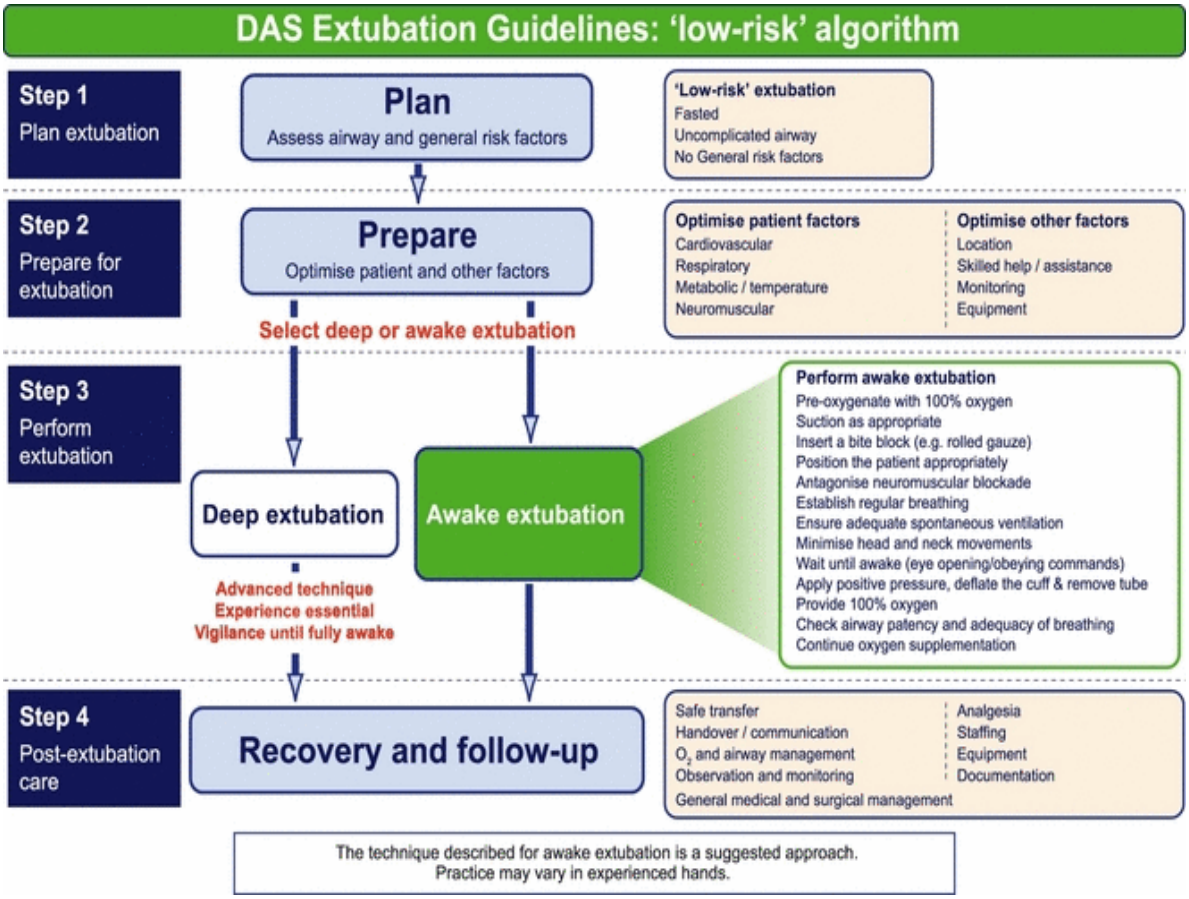

Fig 1: DAS Extubation Guidelines – low-risk algorithm[3]

REFERENCES

1. Foulds L, Dalton A. Extubation and emergence. *Anaesth Intensive Care Med* 2018;**19**(9):465–70.
2. Karmarkar S, Varshney S. Tracheal extubation. *Contin Educ Anaesthes Crit Care Pain* 2008;**8**(6):214–20.
3. Popat M, Mitchell V, Dravid R, *et al*. Difficult airway society guidelines for the management of tracheal extubation. *Anaesthesia* 2012;**67**: 318–40.

Extubation Checklist Date:

Trainee name: Tutor:

Step	
Pre-procedure	
Evaluate extubation risk factors – airway and general	
Confirms surgical procedure complete	
Ensures trained assistant & senior supervision	
Ensures complete reversal of NMB (ToFr > 0.9)	
Confirms cardiovascular stability/normothermia	
Ensures necessary equipment available	
Optimises patient position	
Pre-oxygenates until ETO_2 > 0.8	
Confirms extubation plan with anaesthetic assistant	
Ensure the anaesthetic agent (IV/inhalational) is stopped	
Procedure	
Continues oxygenation	
Performs thorough oropharyngeal toilet	
Inserts bite block (e.g. rolled gauze)	
Confirms adequate spontaneous ventilation	
Confirms patient is obeying simple commands	
Applies positive pressure, deflates the cuff and removes the ETT	
Provides oxygenation (face mask or nasal cannula)	
Confirms patent airway	
Confirms adequate breathing	
Post-procedure	
Documentation	
Safe transfer to recovery area	
Appropriate handover	
Confirms continued monitoring and observation	
Throughout	
Appropriate communication with assistant & patient	
Aware of patient condition/vital signs	

Comments