18th International Congress of Anesthesiology, Critical Care and Pain

Difficult Extubation

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18–20 November 2026 · Tehran, Iran · From Innovation to Resilience

About the Speaker



- Associate professor of anesthesiology
- Tehran University of medical science / Amir Alam hospital
- Airway Management

Outline

1. Extubation
2. Difficult extubation
3. Guidelines
4. Strategies
5. Conclusion and questions

Extubation





Intubation is a skill; Extubation is an art.

Anesthesia and airway management are often compared with flying an airplane.
No one would dispute that its landing is any less important that its takeoff.
Because extubation should be regarded as an elective procedure, this offers the opportunity to anticipate, prepare, and provide safer management.

Effects of extubation and emergence from general anaesthesia

Cause	Effect	Incidence
Airway irritation	Coughing and bucking	18–66%
	Laryngospasm	17–25%
	Desaturation (Spo_2 <90%)	24%
	Inadequate reversal	5–10%
	Post-obstructive pulmonary oedema	0.1%
	Bronchospasm	1%
Reduced level of consciousness/obtunded reflexes	Breath holding	13–20%
	Airway obstruction	5–19%
	Apnoea/hypoventilation	2–9%
	Vomiting/aspiration	2/0.5%
	Laryngeal incompetence	
Cardiovascular changes	Hypertension/tachycardia	10% (haemodynamic instability)
	Arrhythmias	7%*
	Raised intracranial pressure	
	Raised intraocular pressure	
	Myocardial ischaemia	
	Flap disruption/bleeding at surgical site	
Trauma	Dental damage	0.02%
	Airway oedema	
Drug effect	Residual neuromuscular block	5–10%
	Masseter spasm	

ABC approach to extubation

Airway

Ensure the airway is patent
Patient is able to protect airway adequately
Consider inserting a bite block
Remove any throat packs

Breathing

Adequate ventilation, oxygenation and removal of CO_2
- Assess SpO_2 and $PETCO_2$
- Regular ventilatory pattern, breathing with steady rate and tidal volumes
- If using a supported ventilation mode, pressure support and PEEP should be minimal
- Give 100% oxygen

Circulation

Stable blood pressure, heart rate and rhythm

- Normotension without need for high levels of inotrope or vasopressor support
- Adequate fluid balance, normal or improving lactate
- No significant acidosis
- Arrhythmias treated and controlled

Drugs

Confirm reversal of neuromuscular block

Ensure adequate analgesia

Environment

Temperature

- Maintain normothermia

Equipment

- Airway management equipment readily available

Positioning

- Head up or left lateral

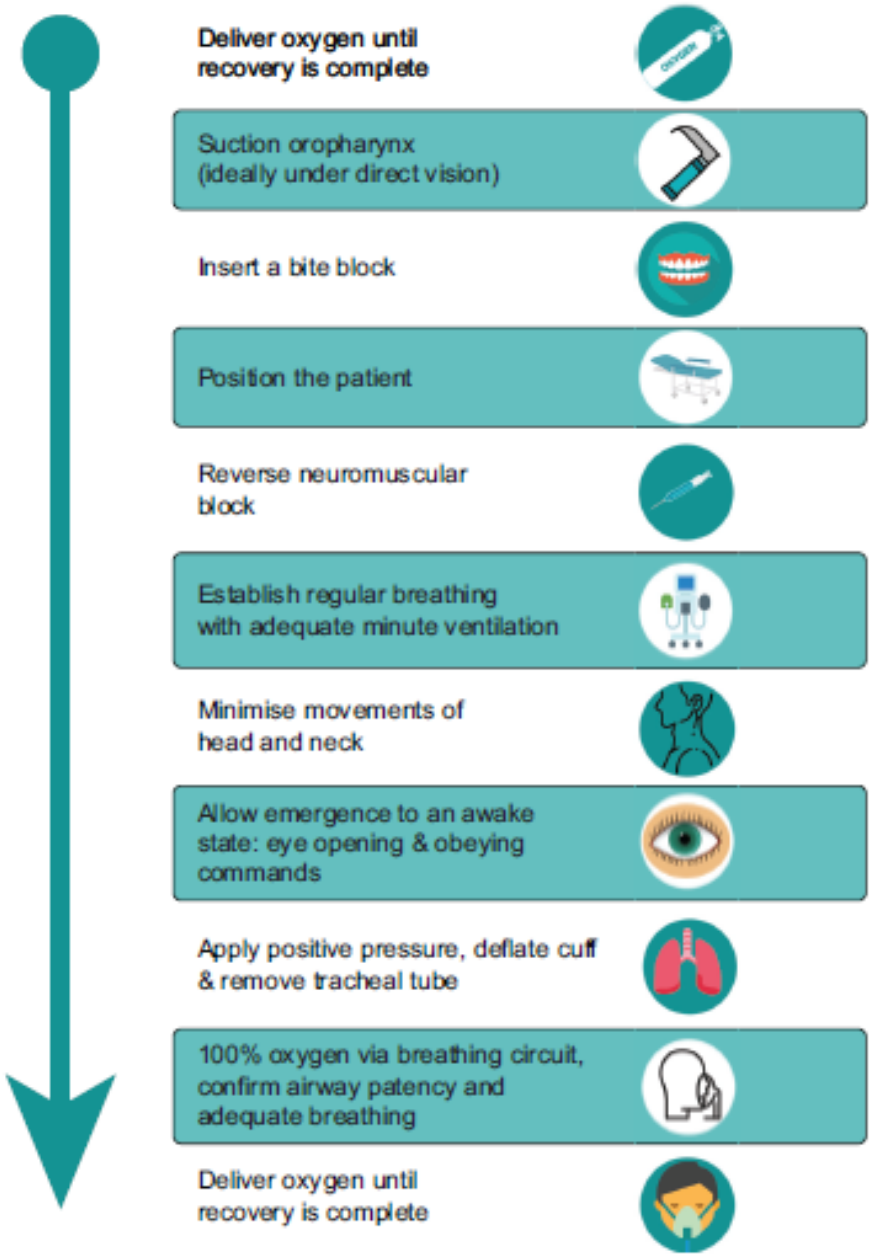
Location

- Suitable location with adequate monitoring and assistance

Human factors

Timing

- Consider time of day, staff availability, levels of fatigue
- Appropriate assistance/expertise available
- Formulate a plan for extubation failure particularly in high-risk cases


Deliver oxygen until recovery is complete
Suction oropharynx (ideally under direct vision)
Insert a bite block
Position the patient
Reverse neuromuscular block
Establish regular breathing with adequate minute ventilation
Minimise movements of head and neck
Allow emergence to an awake state: eye opening & obeying commands
Apply positive pressure, deflate cuff & remove tracheal tube
100% oxygen via breathing circuit, confirm airway patency and adequate breathing
Deliver oxygen until recovery is complete

Extubation Failures and Challenges

Two dimensions contribute to the risk of extubation:

(1) the patient's tolerance of extubation and
(2) the likelihood that reintubation, if required, succeeds free of complications.

Failed extubation

Failure of oxygenation
Failure of ventilation
Inadequate clearance of pulmonary secretions
Loss of airway patency

ICU

Pose a greater risk of extubation failure due to neurologic obtundation, airway edema, debilitation, impaired clearance of secretions, altered pulmonary mechanics, increased dead space, and venous admixture.
Even when reintubation is uneventful, extubation failure is associated with a significant prolongation of ICU stay and an increase in mortality.

CAUSES OF FAILED EXTUBATION

Several attempts for difficult intubation.

Traumatic intubation.

Large diameter, overinflation, malposition of endotracheal tube.

Prolonged surgery (more than 4hrs).

Emergency surgery.

Cervicomaxillofacial surgery.

Prolonged trendelenberg position

Radiotherapy and neck dissection.

Recognition of patients at risk of failing extubation due to airway edema

Inspection, the cuff leak test, and ultrasonography (USG).

Management of airway edema depends on its severity.

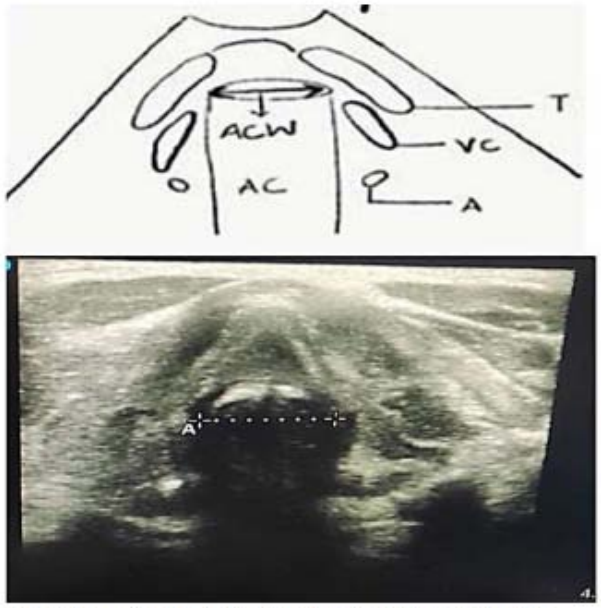


Figure 1C: ACWD (Airway Column Width Difference) with endotracheal tube cuff inflated
ACW=Airway Column Width
T= thyroid cartilage
VC= true vocal cords
AC= laryngeal air column
A=Arytenoid cartilage

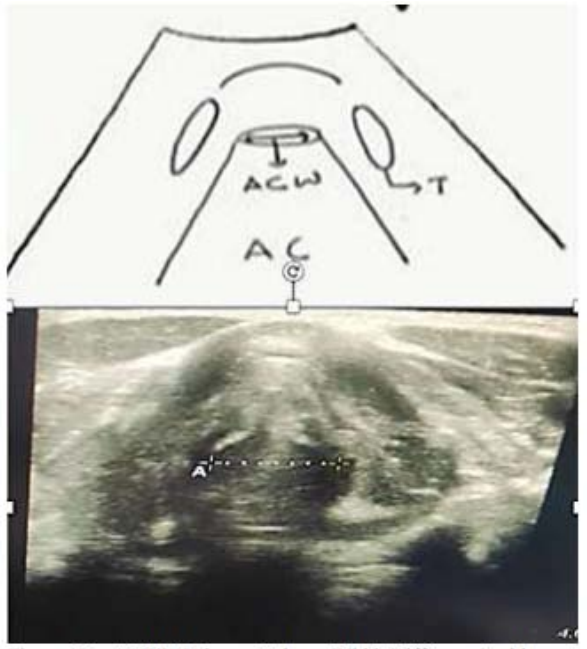


Figure 1D: ACWD (Airway Column Width Difference) with endotracheal tube cuff deflated
ACW=Airway Column Width
T= thyroid cartilage
AC= laryngeal air column

Emergency surgery, nasogastric tubes, and surgery for tonsillectomy, cervical dilation, hypospadias correction, oral endoscopy, or excision of skin lesions appear to be risk factors.

Extubation plan – DAS guideline 2012

Anaesthesia
Journal of the Association of Anaesthetists of Great Britain and Ireland

Guidelines

Difficult Airway Society Guidelines for the management of tracheal extubation

FREE

Membership of the Difficult Airway Society Extubation Guidelines Group: M. Popat (Chairman)[1], V. Mitchell[2], R. Dravid[3], A. Patel[4], C. Swampillai[5], A. Higgs[6]

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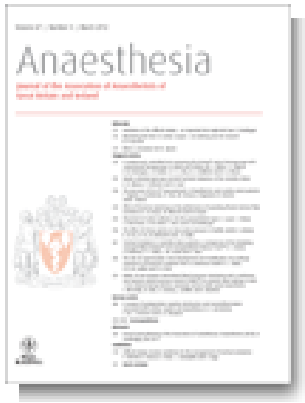
Issue



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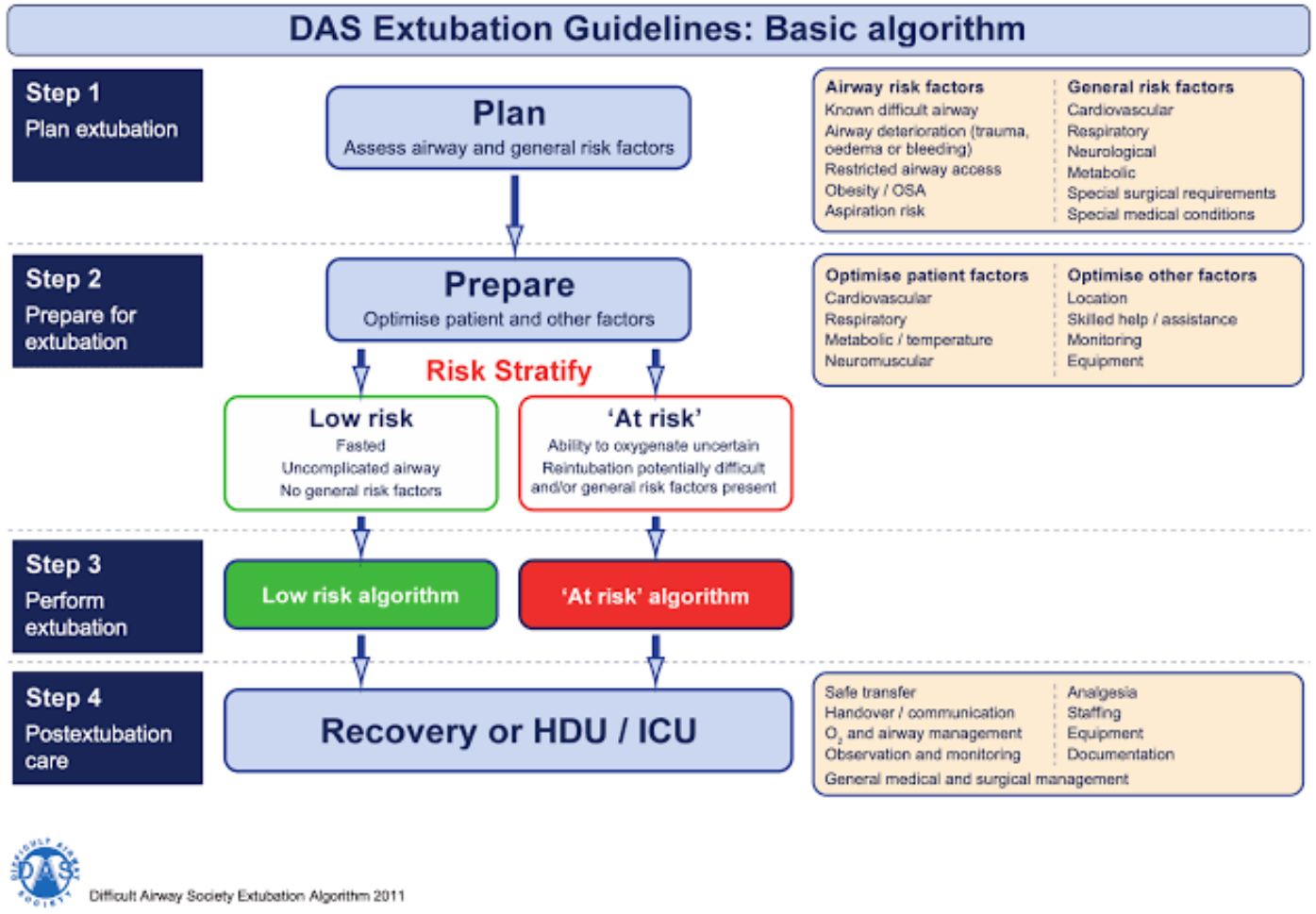
Extubation Process



Extubation Process

DAS Extubation Guidelines: basic algorithm

Step 1

Plan extubation

Plan

Assess airway risk factors
Assess general risk factors



General risk factors
Cardiovascular stability
Respiratory function
Neurological
Metabolic
Special surgical requirements
Special medical conditions

Airway risk factors
Known difficult airway
Deteriorating airway
(trauma, oedema, bleeding)
Restricted airway access
Obesity / OSA
Aspiration risk

Step 2

Prepare for extubation

Prepare

Optimise patient factors

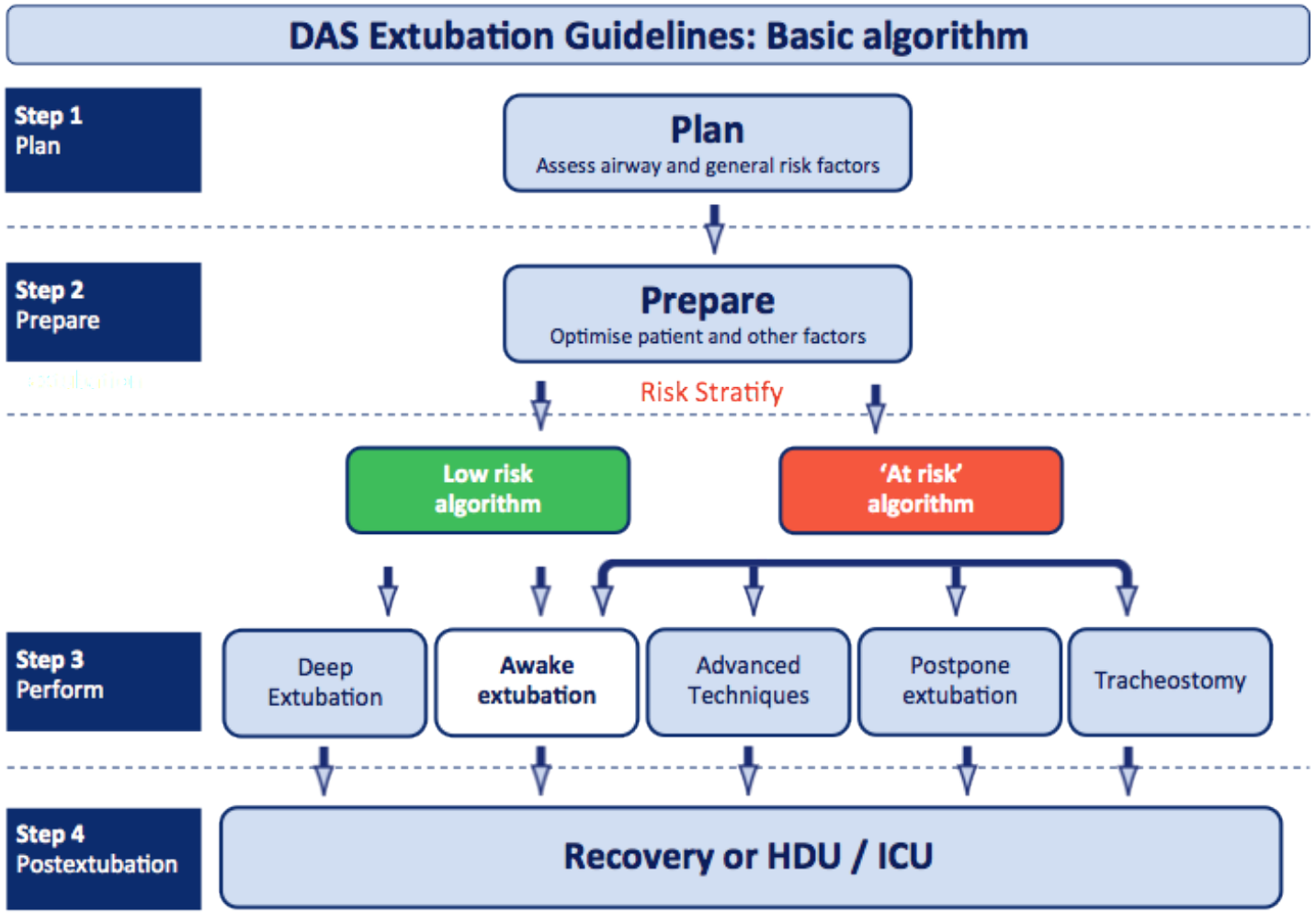
Optimise other factors

Optimise Patient factors

- Cardiovascular
- Respiratory
- Metabolic
- Temperature
- Neuromuscular

Optimise other factors

- Location
- Assistance/Skilled help
- Equipment
- Monitoring


DAS Extubation Guidelines: Basic algorithm
Step 1
Plan
Plan
Assess airway and general risk factors
Step 2
Prepare
Prepare
Optimise patient and other factors
Risk Stratify
Low risk algorithm
'At risk' algorithm
Step 3
Perform
Deep Extubation
Awake extubation
Advanced Techniques
Postpone extubation
Tracheostomy
Step 4
Postextubation
Recovery or HDU / ICU

‘At Risk’ algorithm

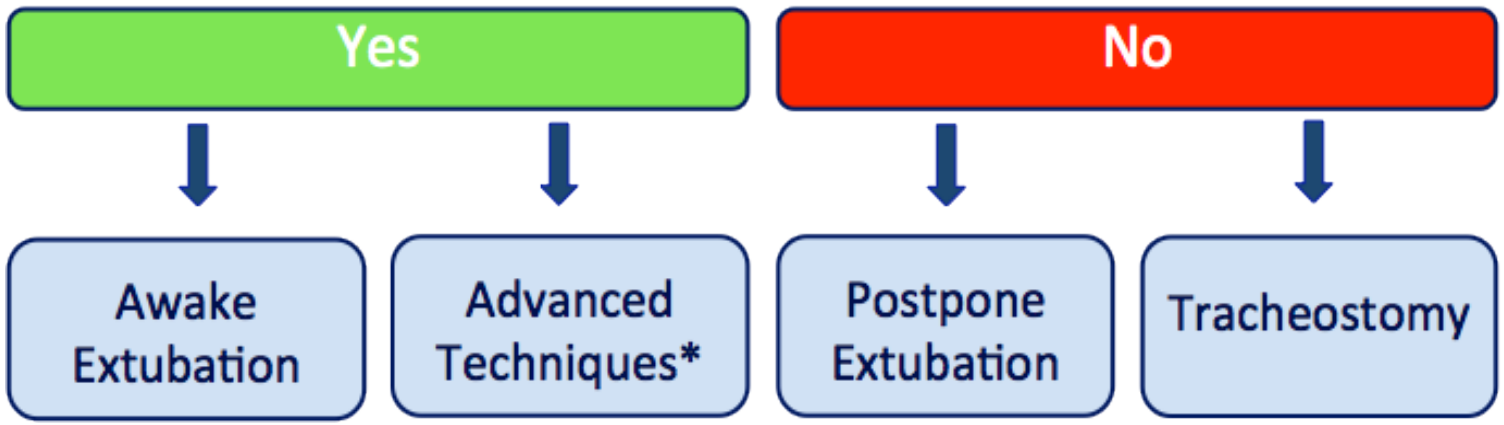
‘At risk’

Ability to oxygenate uncertain
Reintubation may be difficult
+/- general risk factors present

Examples:

- Unstable patient
- Access not guaranteed (e.g. halo, wires)
- Airway distorted (surgery, blood, fluid)
- Difficulty at intubation
- Obese, OSA

Decide: is it safe to remove the tube?



Advanced Techniques*

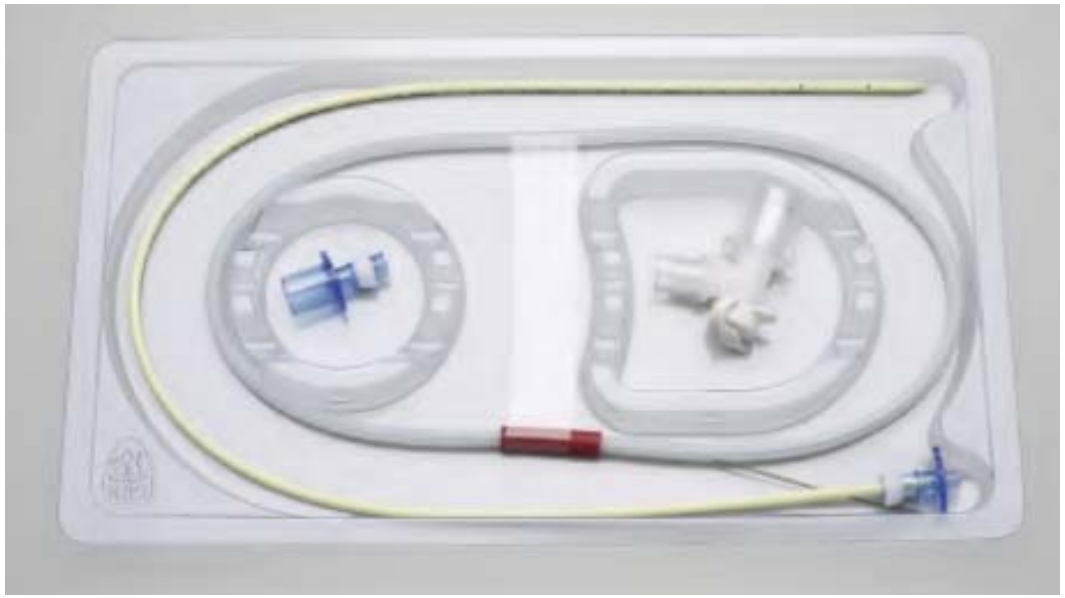
1. LMA Exchange
2. Awake + remifentanil technique
3. Airway exchange catheter

Cricotracheal resection

The patient has been extubated, and a laryngeal mask airway was introduced before reversal of neuromuscular blockade or awakening.



Arndt airway exchange catheter set



Deep Versus Awake Extubation

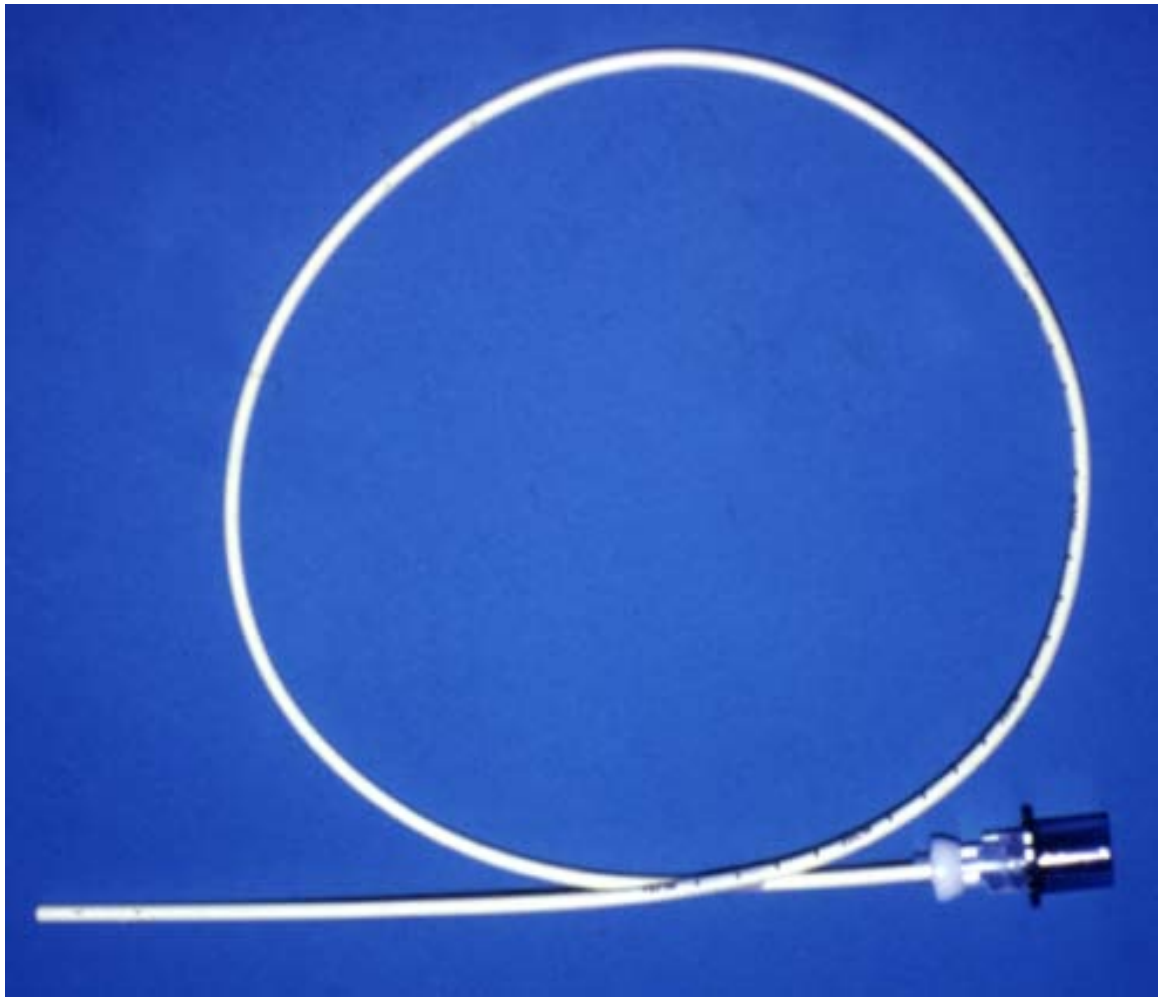
After full recovery of neuromuscular function and the resumption of spontaneous ventilation.
Its purported advantage is the avoidance of the adverse reflexes associated with extubation, such as hypertension, dysrhythmias, coughing, laryngospasm, and increased IOP or ICP.

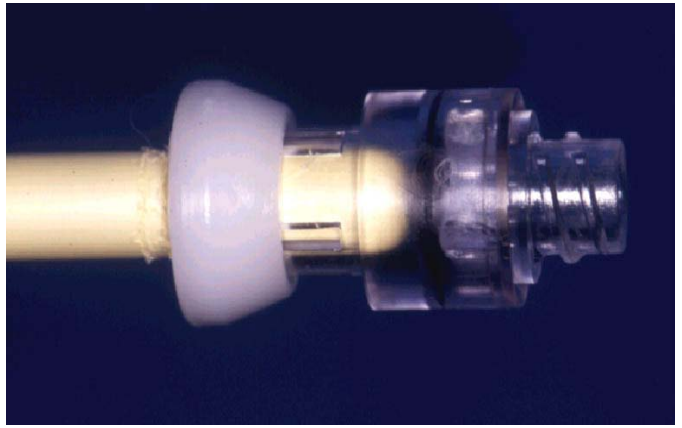
Deep extubation should only be performed if pulmonary aspiration risk is minimal, safe apnoea time is adequate and when there is an expectation that both tracheal re-intubation and ventilation with at least one of the other lifelines (facemask or supraglottic airway) will be rapid and reliable.

The use of an ***airway exchange catheter*** (**AEC**) is most common and recommended by the ASA's Task Force on Management of the Difficult Airway.

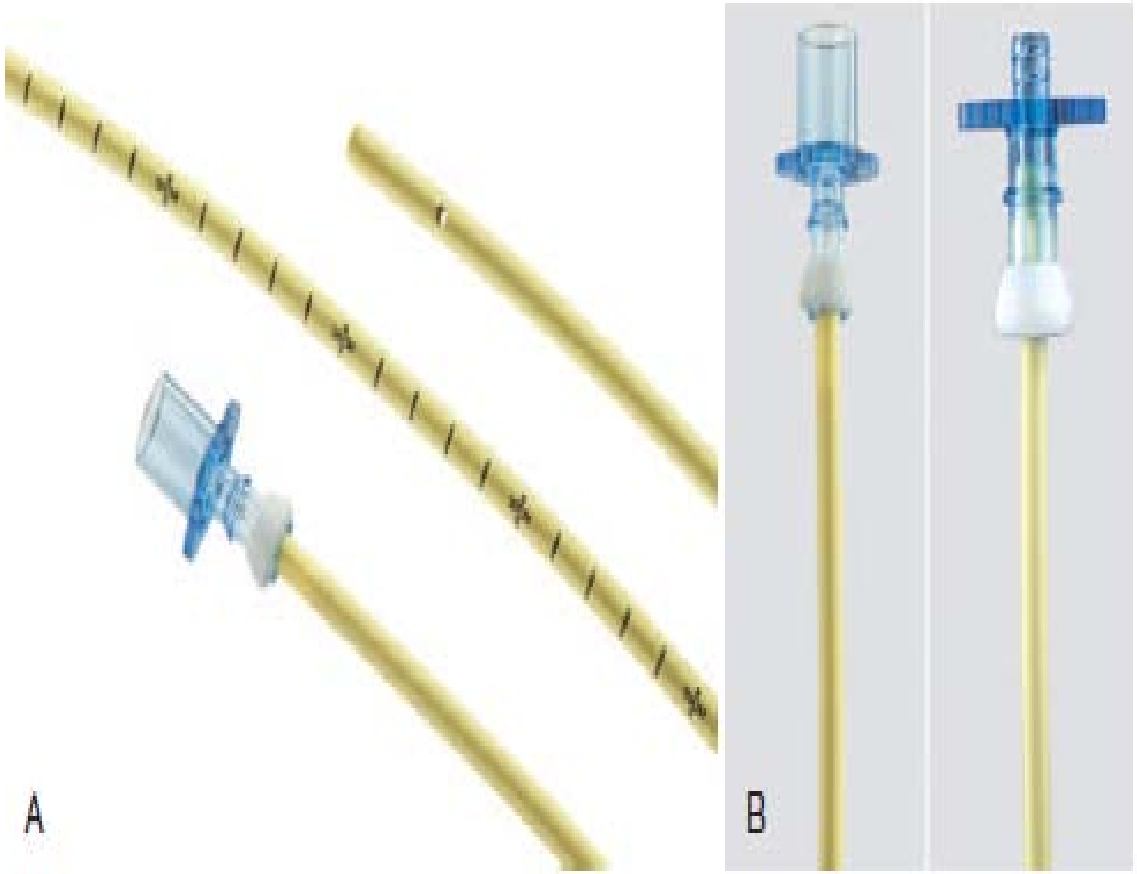
This hollow reintubation guide is passed through the ETT before extubation and kept in situ until the possible need for reintubation has passed.

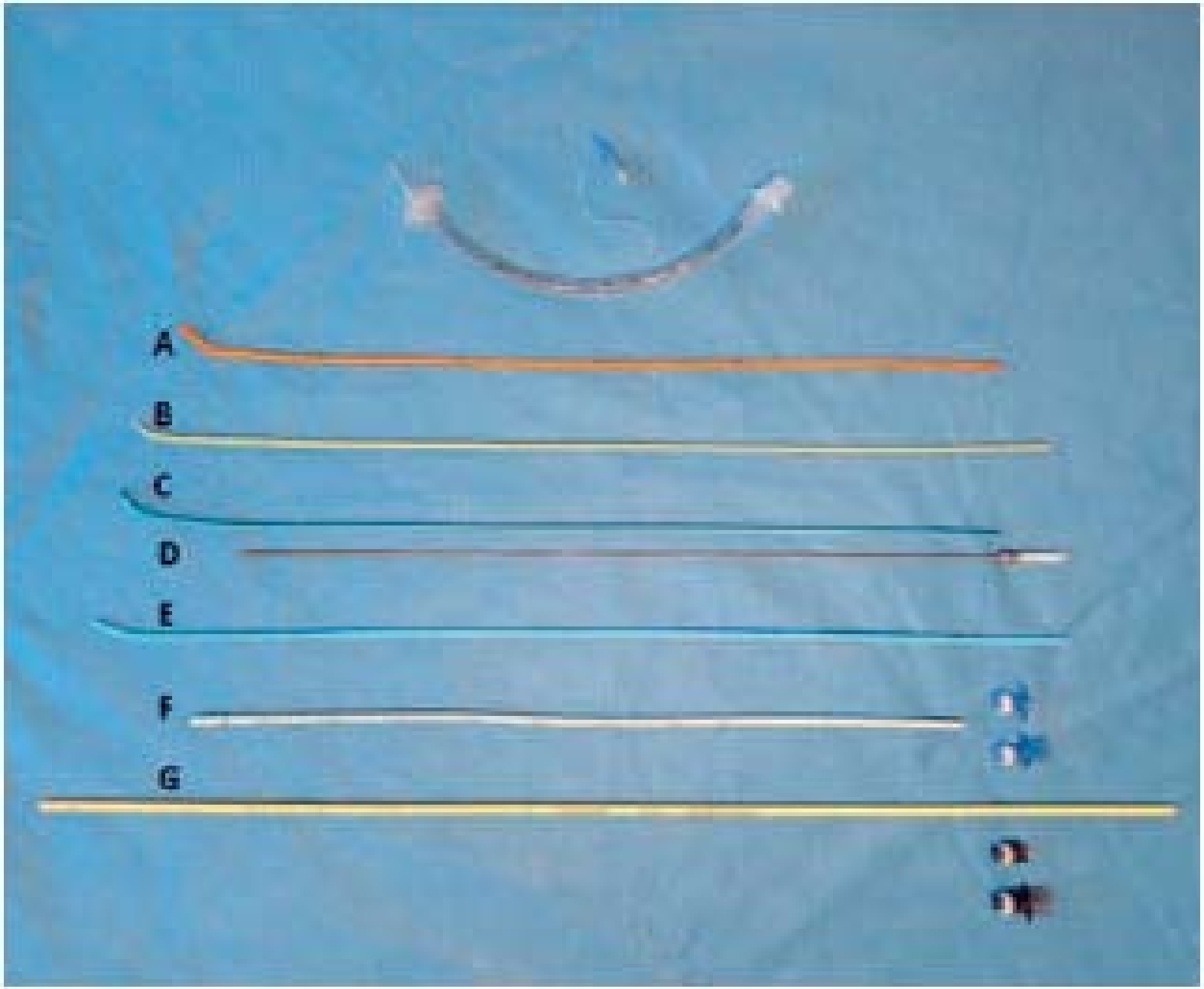
Airway exchanger





Cook® airway exchanger


A
B


A
B
C
D
E
F
G



Airway Exchange Catheters

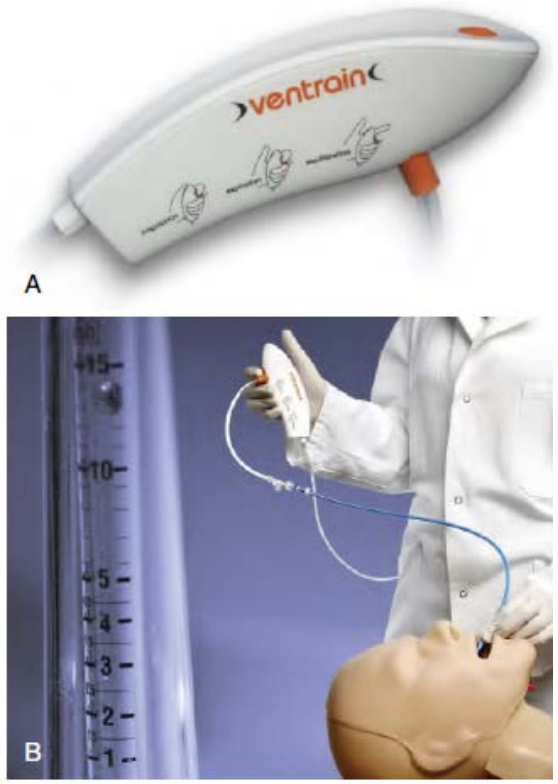
Catheter Fr	Catheter Length /cm	Catheter ID / mm	ETT ID / mm
8	45	1.6	≥ 3
11	83	2.3	≥ 4
14	83	3.0	≥ 5
19	83	3.4	≥ 7

Extra Firm Soft Tipped

Insufflation and Jet Ventilation Through Stylets

Jet ventilation through such a device carries a significant risk of barotrauma, whereas oxygen insufflation has a lower risk.
Significant airway obstruction is a contraindication to the use of an exchange device as a onduit for either insufflation or jet ventilation.
Insufflation should involve low flows (1–2 L/min)

The Ventrain device (Ventinova Medical, Eindhoven, Netherlands) appears to permit safe and effective ventilation through small-bore catheters using the Bernoulli principle to achieve active exhalation.



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Anaesthesia 2026 https://doi.org/10.1111/anae.70365

Guidelines

Project for Universal Management of Airways: guidelines for tracheal extubation

Louise Ellard, Andy Higgs, Richard M. Cooper, Carin A. Hagberg, Paul A. Baker, Robert Greif, George Kovacs, J. Adam Law, Sheila N. Myatra, Ellen P. O'Sullivan, William H. Rosenblatt, Christopher H. Ross, John C. Sakles, Massimiliano Sorbello and **Nicholas C. Chrimes**

Universal Airway Guidelines

Components of a tracheal extubation strategy

INTENDED APPROACH

WHO?

Airway operator and assistant
Additional team members: senior practitioners, specialist expertise, ancillary staff

WHEN?

Planned extubation is ALWAYS elective

WHERE?

Environment for extubation and post-extubation care

HOW?

1. **General considerations:** clearing airway contaminants, gastric decompression, bite block, positioning, recovery of neuromuscular function, level of consciousness
2. **Plan for avoiding harm from hypoxaemia:**
   - **Maintaining airway success**
     Avoiding the need for tracheal re-intubation
     Facilitating successful tracheal re-intubation if required
     Post-extubation care
   - **Extending the safe apnoea time** SpO_2
3. **Plan for avoiding pulmonary aspiration**
4. **Plan for avoiding harm from airway stimulation**
5. **Plan for addressing any other identified risks** ?

RESCUE APPROACH

WHAT
IS THE PLAN IF THAT PLAN FAILS?

Plan for accessing help: target, trigger, initiator, contact info
Plan for achieving a best effort at each airway lifeline
Plan for priming for neck rescue
Plan for exploiting airway success

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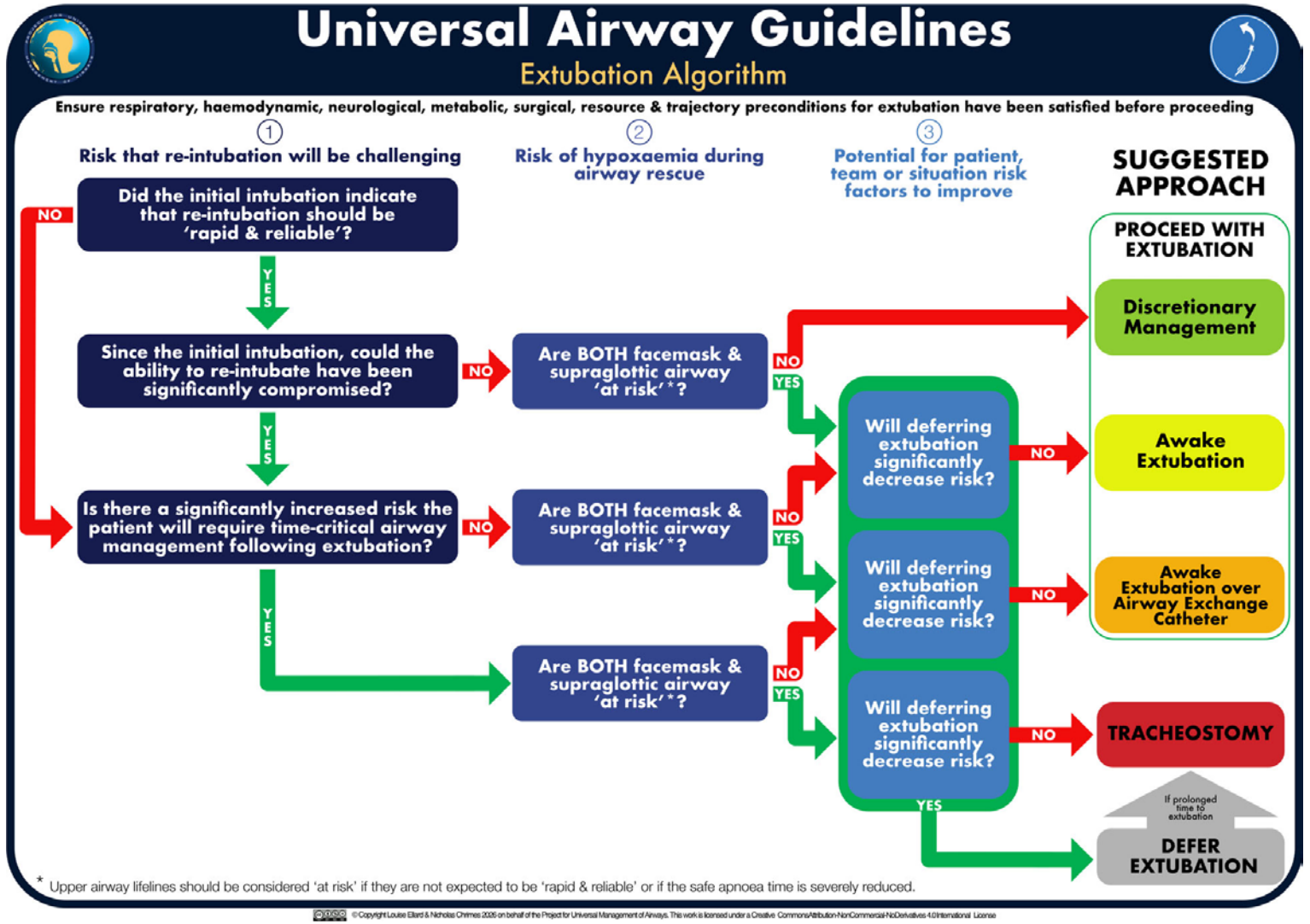
Universal Airway Guidelines
Extubation Algorithm
Ensure respiratory, haemodynamic, neurological, metabolic, surgical, resource & trajectory preconditions for extubation have been satisfied before proceeding
1
Risk that re-intubation will be challenging
2
Risk of hypoxaemia during airway rescue
3
Potential for patient, team or situation risk factors to improve
SUGGESTED APPROACH
Did the initial intubation indicate that re-intubation should be 'rapid & reliable'?
NO
YES
Since the initial intubation, could the ability to re-intubate have been significantly compromised?
NO
YES
Is there a significantly increased risk the patient will require time-critical airway management following extubation?
NO
YES
Are BOTH facemask & supraglottic airway 'at risk'*?
NO
YES
Are BOTH facemask & supraglottic airway 'at risk'*?
NO
YES
Are BOTH facemask & supraglottic airway 'at risk'*?
NO
YES
Will deferring extubation significantly decrease risk?
NO
Will deferring extubation significantly decrease risk?
NO
Will deferring extubation significantly decrease risk?
NO
YES
PROCEED WITH EXTUBATION
Discretionary Management
Awake Extubation
Awake Extubation over Airway Exchange Catheter
TRACHEOSTOMY
If prolonged time to extubation
DEFER EXTUBATION
* Upper airway lifelines should be considered 'at risk' if they are not expected to be 'rapid & reliable' or if the safe apnoea time is severely reduced.
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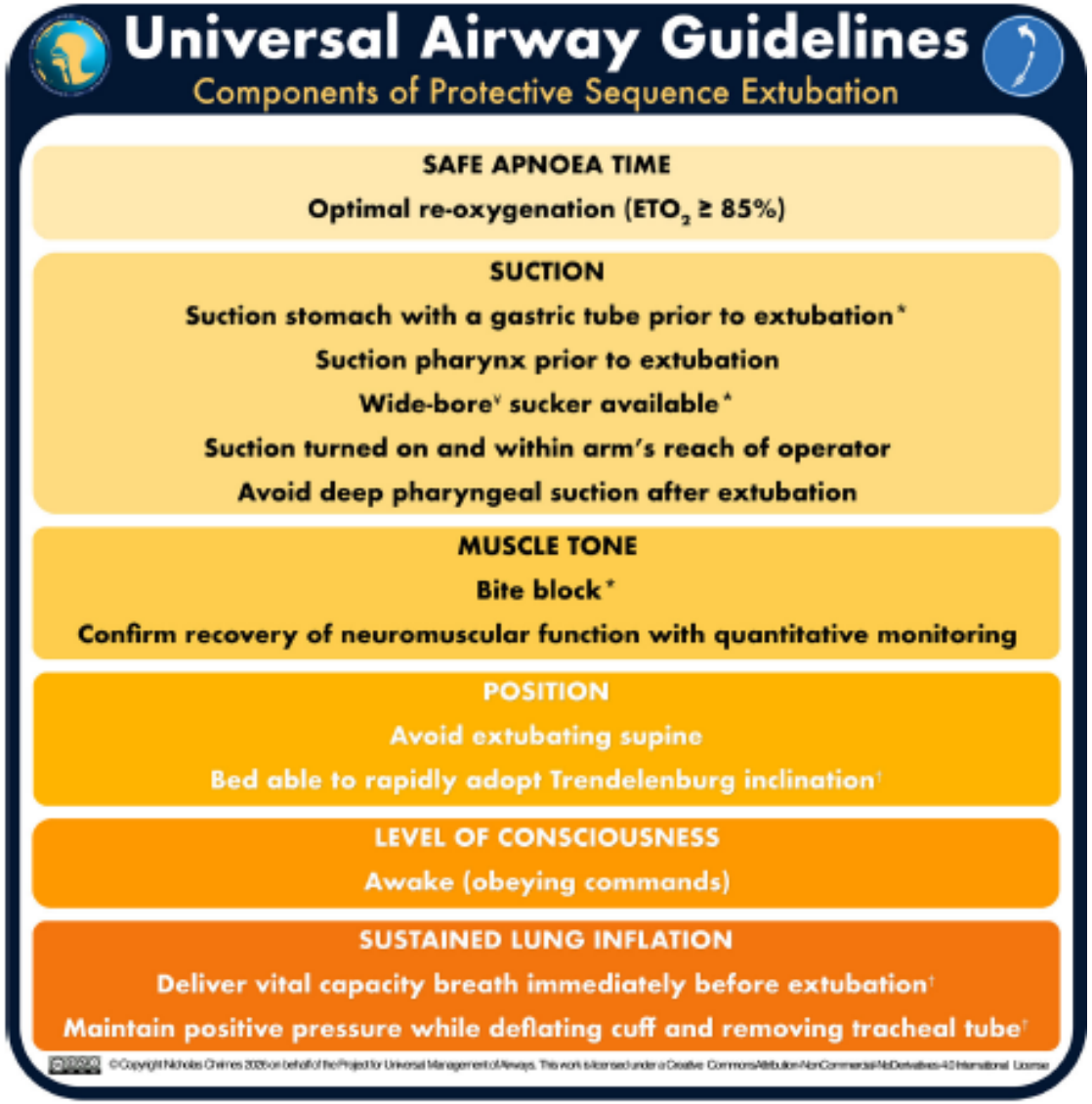
Universal Airway Guidelines
Components of Protective Sequence Extubation
SAFE APNOEA TIME
Optimal re-oxygenation (ETO_2 ≥ 85%)
SUCTION
Suction stomach with a gastric tube prior to extubation*
Suction pharynx prior to extubation
Wide-bore^v sucker available^
Suction turned on and within arm's reach of operator
Avoid deep pharyngeal suction after extubation
MUSCLE TONE
Bite block*
Confirm recovery of neuromuscular function with quantitative monitoring
POSITION
Avoid extubating supine
Bed able to rapidly adopt Trendelenburg inclination†
LEVEL OF CONSCIOUSNESS
Awake (obeying commands)
SUSTAINED LUNG INFLATION
Deliver vital capacity breath immediately before extubation†
Maintain positive pressure while deflating cuff and removing tracheal tube†
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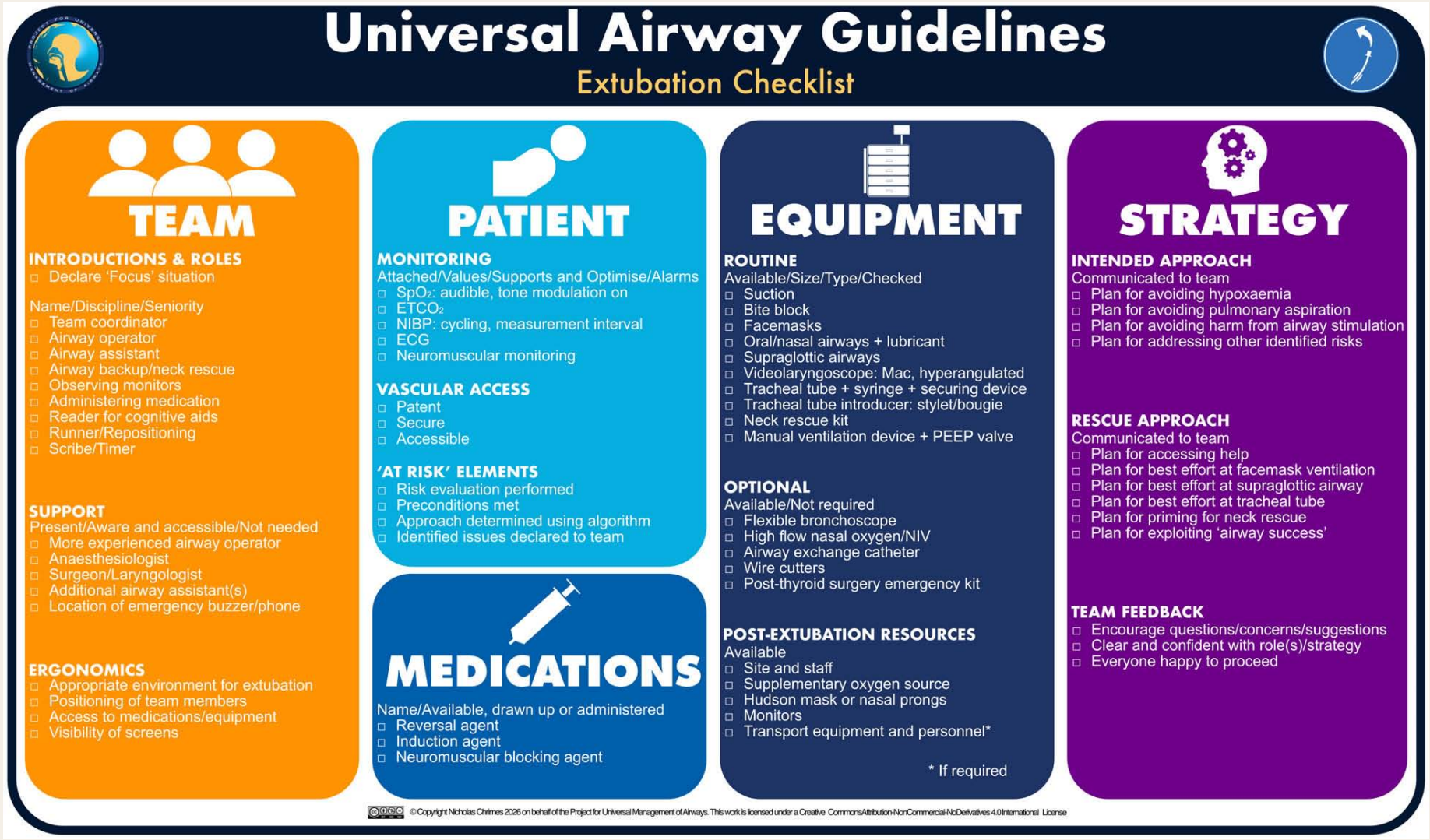
Universal Airway Guidelines
Extubation Checklist
TEAM
INTRODUCTIONS & ROLES
Declare 'Focus' situation
Name/Discipline/Seniority
Team coordinator
Airway operator
Airway assistant
Airway backup/neck rescue
Observing monitors
Administering medication
Reader for cognitive aids
Runner/Repositioning
Scribe/Timer
SUPPORT
Present/Aware and accessible/Not needed
More experienced airway operator
Anaesthesiologist
Surgeon/Laryngologist
Additional airway assistant(s)
Location of emergency buzzer/phone
ERGONOMICS
Appropriate environment for extubation
Positioning of team members
Access to medications/equipment
Visibility of screens
PATIENT
MONITORING
Attached/Values/Supports and Optimise/Alarms
SpO2: audible, tone modulation on
ETCO2
NIBP: cycling, measurement interval
ECG
Neuromuscular monitoring
VASCULAR ACCESS
Patent
Secure
Accessible
'AT RISK' ELEMENTS
Risk evaluation performed
Preconditions met
Approach determined using algorithm
Identified issues declared to team
MEDICATIONS
Name/Available, drawn up or administered
Reversal agent
Induction agent
Neuromuscular blocking agent
EQUIPMENT
ROUTINE
Available/Size/Type/Checked
Suction
Bite block
Facemasks
Oral/nasal airways + lubricant
Supraglottic airways
Videolaryngoscope: Mac, hyperangulated
Tracheal tube + syringe + securing device
Tracheal tube introducer: stylet/bougie
Neck rescue kit
Manual ventilation device + PEEP valve
OPTIONAL
Available/Not required
Flexible bronchoscope
High flow nasal oxygen/NIV
Airway exchange catheter
Wire cutters
Post-thyroid surgery emergency kit
POST-EXTUBATION RESOURCES
Available
Site and staff
Supplementary oxygen source
Hudson mask or nasal prongs
Monitors
Transport equipment and personnel*
* If required
STRATEGY
INTENDED APPROACH
Communicated to team
Plan for avoiding hypoxaemia
Plan for avoiding pulmonary aspiration
Plan for avoiding harm from airway stimulation
Plan for addressing other identified risks
RESCUE APPROACH
Communicated to team
Plan for accessing help
Plan for best effort at facemask ventilation
Plan for best effort at supraglottic airway
Plan for best effort at tracheal tube
Plan for priming for neck rescue
Plan for exploiting 'airway success'
TEAM FEEDBACK
Encourage questions/concerns/suggestions
Clear and confident with role(s)/strategy
Everyone happy to proceed
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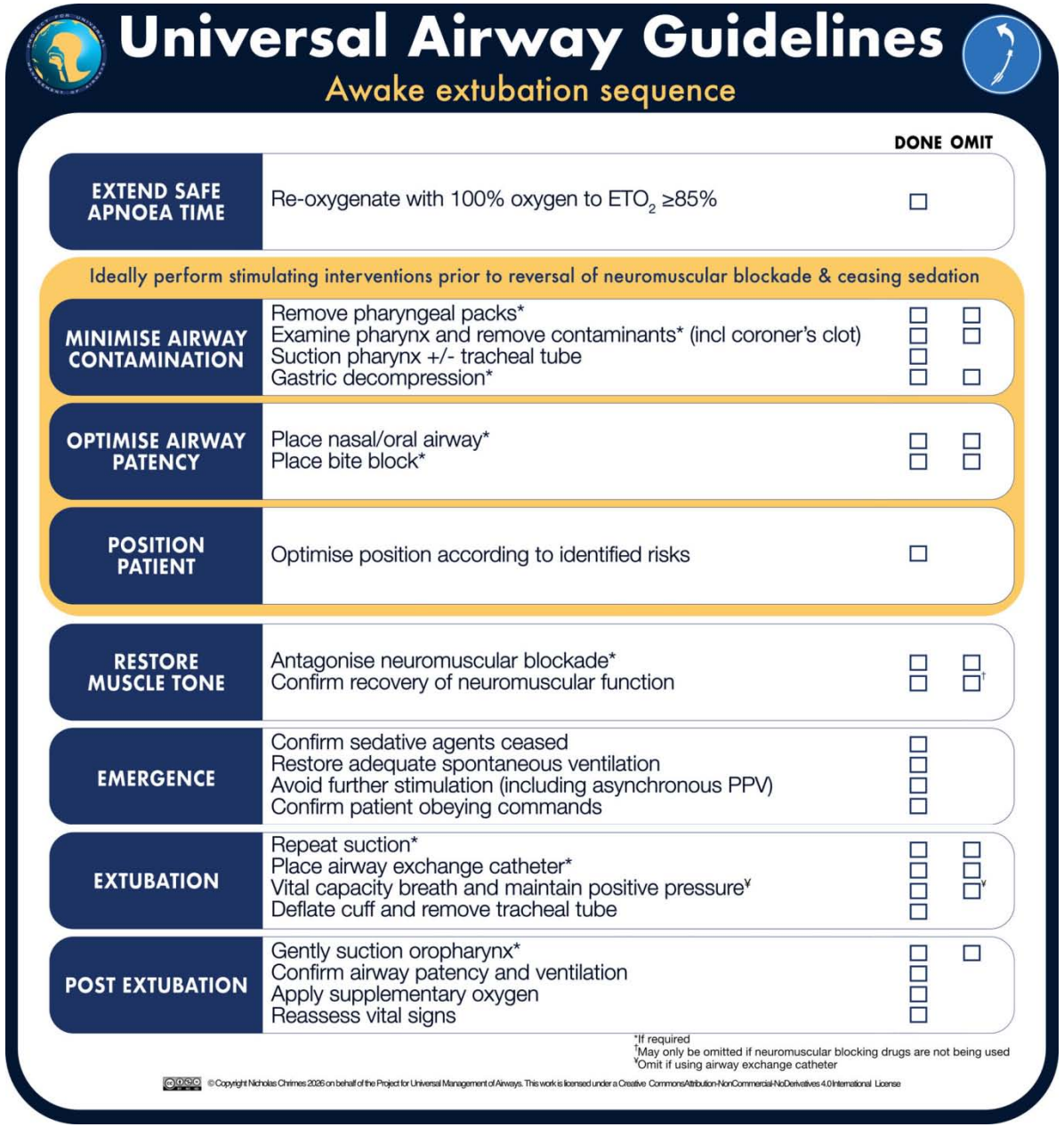
Universal Airway Guidelines
Awake extubation sequence
DONE OMIT
EXTEND SAFE APNOEA TIME
Re-oxygenate with 100% oxygen to ETO_2 ≥85%
Ideally perform stimulating interventions prior to reversal of neuromuscular blockade & ceasing sedation
MINIMISE AIRWAY CONTAMINATION
Remove pharyngeal packs*
Examine pharynx and remove contaminants* (incl coroner's clot)
Suction pharynx +/- tracheal tube
Gastric decompression*
OPTIMISE AIRWAY PATENCY
Place nasal/oral airway*
Place bite block*
POSITION PATIENT
Optimise position according to identified risks
RESTORE MUSCLE TONE
Antagonise neuromuscular blockade*
Confirm recovery of neuromuscular function
EMERGENCE
Confirm sedative agents ceased
Restore adequate spontaneous ventilation
Avoid further stimulation (including asynchronous PPV)
Confirm patient obeying commands
EXTUBATION
Repeat suction*
Place airway exchange catheter*
Vital capacity breath and maintain positive pressure¥
Deflate cuff and remove tracheal tube
POST EXTUBATION
Gently suction oropharynx*
Confirm airway patency and ventilation
Apply supplementary oxygen
Reassess vital signs
*If required
†May only be omitted if neuromuscular blocking drugs are not being used
¥Omit if using airway exchange catheter
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MANAGEMENT OF LARYNGOSPASM

INITIAL MANAGEMENT

Consider calling for help

Remove potential precipitants
(consider aspiration, minimise stimulation)

100% Oxygen

Optimise upper airway patency

CPAP via tight-fitting facemask

Larson's manoeuvre*

Low dose propofol

REFRACTORY MANAGEMENT

If laryngospasm persists or desaturation/bradycardia occurs

Call for help

Induction dose propofol

Intubating dose suxamethonium or rocuronium

AIRWAY OBSTRUCTION OR HIGH VENTILATION PRESSURE THAT DOES NOT RESOLVE WITH AN INTUBATING DOSE OF NMBD IS NOT DUE TO LARYNGOSPASM.

THE MANAGEMENT OF BRADYCARDIA OCCURRING SECONDARY TO HYPOXAEMIA IS TO RESOLVE HYPOXAEMIA RATHER THAN TO ADMINISTER ATROPINE†.

*Larson's manoeuvre: bilateral intense force applied high up between the posterior ramus of mandible & the mastoid process, just below the skull base. Force is directed medially, superiorly and posteriorly, towards the styloid process.

†Administration of atropine is appropriate to treat bradycardia associated with use of suxamethonium

Doses
Low dose propofol: 0.25mg/kg IV
Induction dose propofol: 2-4mg/kg IV
Intubating dose suxamethonium: 1-2mg/kg IV/IO, 2-4mg/kg IM
Intubating dose rocuronium: 1.5mg/kg IV

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Safe landing is equally important



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Take-Home Messages

1

Message one

Safe landing is equally important

2

Message two

Airway risk factors

General risk factors

3

Message three

Optimise factors

Extubation strategies

References

Anaesthesia 2026 https://doi.org/10.1111/anae.70365

Guidelines

Project for Universal Management of Airways: guidelines for tracheal extubation

Louise Ellard, Andy Higgs, Richard M. Cooper, Carin A. Hagberg, Paul A. Baker, Robert Greif, George Kovacs, J. Adam Law, Sheila N. Myatra, Ellen P. O'Sullivan, William H. Rosenblatt, Christopher H. Ross, John C. Sakles, Massimiliano Sorbello and **Nicholas C. Chrimes**

Summary

Introduction Risk evaluation, strategy formulation and preparation are important to decreasing the incidence of adverse events associated with tracheal extubation. The focus of this guideline is tracheal extubation, but

Anaesthesia 2025, 80, 1556–1567 doi:10.1111/anae.16751

Review Article

Point-of-care ultrasound of the upper airway in difficult airway management: a systematic review and meta-analysis*

Vedish M. Soni, Ameya Pappu, Sahar Zarabi, Carlos Khalil, Kong E. You-Ten, Naveed Siddiqui, David T. Wong, Vincent Chan, Qixuan Li, Ella Huzsti, Marina. Englesakis and **Mandeep Singh**

AIDAA Guidelines

All India Difficult Airway Association 2025 guidelines for extubation of the "at-risk" airway

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Safe tracheal extubation after general anaesthesia

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Keywords: airway management; general anaesthesia; tracheal extubation

Learning objectives
By reading this article, you should be able to:
- List the complications occurring during emer-

Key points
- Complications during emergence, extubation and in the PACU are common and can be life-

Thank You for Your Attention

Questions and Discussion