Extubation
5th British-Ukrainian Symposium Trends in Anaesthesiology, Pain Medicine and ITU
April 2013

Viki Mitchell
University College London Hospitals
Plan A: Initial tracheal intubation plan
- Direct laryngoscopy
  - succeed: Tracheal intubation
  - fail: re-intubation

Plan B: Secondary tracheal intubation plan
- ILMA™ or LMA™
  - succeed: Confirm - then fibreoptic tracheal intubation through ILMA™ or LMA™
  - fail: return to face mask

Plan C: Maintenance of oxygenation, ventilation, postponement of surgery and awakening
- Revert to face mask
  - Oxygenate & ventilate
  - succeed: Postpone surgery
  - fail: Cannula cricothyroidotomy or Surgical cricothyroidotomy

Plan D: Rescue techniques for "can't intubate, can't ventilate" situation
- LMA™
  - succeed: Improved oxygenation
  - fail: Awaken patient or increasing hypoxaemia

http://das.uk.com
Management of the Difficult Airway: a Closed Claims Analysis

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Induction</td>
<td>71%</td>
<td>63%</td>
</tr>
<tr>
<td>Extubation</td>
<td>8%</td>
<td>14%</td>
</tr>
<tr>
<td>Recovery</td>
<td>3%</td>
<td>7%</td>
</tr>
</tbody>
</table>

Peterson GN, Domino KB, Caplan RA, Posner KL, Lee LA, Cheney FW. Anesthesiology 2005:103;33-39
Major Complications of Airway Management NAP4
38/133 cases in anaesthesia group (28%)

- 2 Deaths
- 1 Brain damage
Laryngospasm
POPO 10% of all cases 13/38
Airway surgery 18/38
Oedema: head down position 3/38
Obesity, asthma, COPD
The executive summary highlighted:

Failure to plan for failure
Poor judgement
Lack of training and education
Difficult Airway Society guidelines for management of unanticipated difficult intubation 2004

An airway strategy should be drawn up for each patient to cover the entire period of anaesthetic care, particularly at the start and end of anaesthesia.

A strategy, not a plan
DAS Extubation Guidelines: Basic algorithm

Step 1
Plan extubation

**Plan**
Assess airway and general risk factors

Step 2
Prepare for extubation

**Prepare**
Optimise patient and other factors

**Risk Stratify**

- **Low risk**
  - Fasted
  - Uncomplicated airway
  - No general risk factors

- **‘At risk’**
  - Ability to oxygenate uncertain
  - Reintubation potentially difficult
  - and/or general risk factors present

Step 3
Perform extubation

- **Low risk algorithm**
- **‘At risk’ algorithm**

Step 4
Postextubation care

**Recovery or HDU / ICU**

- Safe transfer
- Handover / communication
- O₂ and airway management
- Observation and monitoring
- General medical and surgical management

- Analgesia
- Staffing
- Equipment
- Documentation
Perform Awake Extubation

Preoxygenate with 100% oxygen
Suction as appropriate
Insert a bite block (e.g. rolled gauze)
Position the patient appropriately
Antagonise neuromuscular blockade
Establish regular breathing
Ensure adequate spontaneous ventilation
Minimise head and neck movements
Wait until awake (eye opening/obeying commands)
Apply positive pressure, deflate the cuff & remove tube
Provide 100% oxygen
Check airway patency and adequacy of breathing

Low risk extubation
Fasted
Uncomplicated airway
No General risk factors

Optimise patient factors
Cardiovascular
Respiratory
Metabolic / temperature
Neuromuscular

Optimise other factors
Location
Skilled help / assistance
Monitoring
Equipment

DAS Extubation Guidelines: Low risk algorithm

Step 1
Plan extubation

Step 2
Prepare for extubation

Step 3
Perform extubation

Step 4
Postextubation care

Plan
Assess airway and general risk factors

Prepare
Optimise patient and other factors

Select deep or awake extubation

Deep Extubation
Advanced technique
Experience essential
Vigilance until fully awake

Awake Extubation

Recovery and follow up

Low risk extubation
Fasted
Uncomplicated airway
No General risk factors

The technique described for awake extubation is a suggested approach. Practice may vary in experienced hands.
**DAS Extubation Guidelines: ‘At risk’ algorithm**

### Step 1: Plan extubation
- **Plan**
  - Assess airway and general risk factors
- **‘At risk’ extubation**
  - Ability to oxygenate uncertain
  - Reintubation potentially difficult
  - and/or general risk factors present

### Step 2: Prepare for extubation
- **Prepare**
  - Optimize patient and other factors
- **Optimize patient factors**
  - Cardiovascular
  - Respiratory
  - Metabolic / temperature
  - Neuromuscular
- **Optimize other factors**
  - Location
  - Skilled help / assistance
  - Monitoring
  - Equipment

### Key question: is it safe to remove the tube?

#### Step 3: Perform extubation
- **Yes**
  - Awake extubation
  - Advanced Techniques*:
    - 1. Laryngeal mask exchange
    - 2. Remifentanil technique
    - 3. Airway Exchange Catheter
- **No**
  - Postpone extubation
  - Tracheostomy

### Step 4: Postextubation care
- **Recovery or HDU / ICU**
  - Safe transfer
  - Handover / communication
  - O₂ and airway management
  - Observation and monitoring
- **Analgesia**
  - Staffing
  - Equipment
  - Documentation
- **General medical and surgical management**

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*Advanced techniques: require training and experience*
Extubation strategy: a series of steps

Risk Stratification of Extubation

1. Plan
2. Prepare
3. Perform
4. Post-extubation care

Step 1
Step 2
Step 3
Step 4
## DAS Extubation Guidelines: Basic algorithm

### Step 1
Plan extubation

### Plan
Assess airway and general risk factors

<table>
<thead>
<tr>
<th>Airway risk factors</th>
<th>General risk factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Known difficult airway</td>
<td>Cardiovascular stability</td>
</tr>
<tr>
<td>Deteriorating airway (trauma, oedema, bleeding)</td>
<td>Respiratory function</td>
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<tr>
<td>Restricted airway access</td>
<td>Neurological</td>
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<tr>
<td>Obesity / OSA</td>
<td>Metabolic</td>
</tr>
<tr>
<td>Aspiration risk</td>
<td>Special surgical requirements</td>
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<tbody>
<tr>
<td>Known difficult airway</td>
<td>Special medical conditions</td>
</tr>
<tr>
<td>Airway deterioration (trauma, oedema or bleeding)</td>
<td>Special surgical requirements</td>
</tr>
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Difficult Airway Society Extubation Algorithm 2011

DAS Extubation Guidelines: Basic algorithm

**Step 1**
Plan extubation

- **Plan**
  - Assess airway and general risk factors

- **Airway risk factors**
  - Known difficult airway
  - Airway deterioration (trauma, oedema or bleeding)
  - Restricted airway access
  - Obesity / OSA
  - Aspiration risk

- **General risk factors**
  - Cardiovascular
  - Respiratory
  - Neurological
  - Metabolic
  - Special surgical requirements
  - Special medical conditions

- **Optimise patient factors**
  - Cardiovascular
  - Respiratory
  - Metabolic / temperature
  - Neuromuscular

- **Optimise other factors**
  - Location
  - Assistance / Skilled help
  - Equipment
  - Monitoring

**Step 2**
Prepare for extubation

- **Prepare**
  - Optimise patient and other factors

- **Optimise patient factors**
  - Cardiovascular
  - Respiratory
  - Metabolic
  - Temperature
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**‘At risk’**
- Ability to oxygenate uncertain
- Reintubation potentially difficult
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**Airway risk factors**
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**General risk factors**
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Plan extubation

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**Step 3**
Perform extubation

- **Low risk algorithm**
- **‘At risk’ algorithm**
Low risk

Fasted

Uncomplicated airway

No general risk factors
DAS Extubation Guidelines: Low risk algorithm

**Low risk extubation**
- Fasted
- Uncomplicated airway
- No General risk factors

**Optimise patient factors**
- Cardiovascular
- Respiratory
- Metabolic / temperature
- Neuromuscular

**Optimise other factors**
- Location
- Skilled help / assistance
- Monitoring
- Equipment

**Perform Awake Extubation**
- Preoxygenate with 100% oxygen
- Suction as appropriate
- Insert a bite block (e.g. rolled gauze)
- Position the patient appropriately
- Antagonise neuromuscular blockade
- Establish regular breathing
- Ensure adequate spontaneous ventilation
- Minimise head and neck movements
- Wait until awake (eye opening/obeying commands)
- Apply positive pressure, deflate the cuff & remove tube
- Provide 100% oxygen
- Check airway patency and adequacy of breathing

★ Advanced technique
★ Experience needed
★ Airway at risk until fully awake

The technique described for awake extubation is a suggested approach. Practice may vary in experienced hands.
Low risk
- Fasted
- Uncomplicated airway
- No general risk factors

Awake extubation

- Preoxygenate with 100% oxygen
- Suction as appropriate
- Insert a bite block eg rolled gauze
- Position the patient appropriately
- Antagonise neuromuscular blockade
- Establish regular respiration
- Ensure adequate spontaneous ventilation
- Minimise head and neck movements
- Wait until awake
- Apply +ve pressure, deflate cuff, remove tube
- Provide 100% oxygen
- Check airway patency & breathing
- Continue oxygen supplementation
Bite block
**DAS Extubation Guidelines: Basic algorithm**

**Step 1**
Plan extubation

**Step 2**
Prepare for extubation

**Plan**
Assess airway and general risk factors

**Prepare**
Optimise patient and other factors

**Risk Stratify**

**Low risk**
Fasted
Uncomplicated airway
No general risk factors

**‘At risk’**
Ability to oxygenate uncertain
Reintubation potentially difficult
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**Step 3**
Perform extubation

**Low risk algorithm**

**‘At risk’ algorithm**

**Step 4**
Postextubation care

**Recovery or HDU / ICU**

**Airway risk factors**
- Known difficult airway
- Airway deterioration
  (trauma, oedema or bleeding)
- Restricted airway access
- Obesity / OSA
- Aspiration risk

**General risk factors**
- Cardiovascular
- Respiratory
- Neurological
- Metabolic
- Special surgical requirements
- Special medical conditions

**Optimise patient factors**
- Cardiovascular
- Respiratory
- Metabolic / temperature
- Neuromuscular

**Optimise other factors**
- Location
- Skilled help / assistance
- Monitoring
- Equipment

**Safe transfer**
- Handover / communication
- \( O_2 \) and airway management
- Observation and monitoring
- Analgesia
- Staffing
- Equipment
- Documentation

**General medical and surgical management**
‘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?

No

Postpone Extubation

Tracheostomy
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?

Yes
- Awake Extubation
- Advanced Techniques*

No
- Postpone Extubation
- Tracheostomy

*Advanced Techniques include techniques such as fiberoptic intubation or surgical intubation.
Advanced Techniques*
1. LMA Exchange
2. Awake + remifentanil technique
3. Airway exchange catheter
1. LMA exchange

Complications at extubation

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<tr>
<th></th>
<th>None</th>
<th>Bucking</th>
<th>SpO2 &lt;95%</th>
<th>Obst’n</th>
<th>Cough</th>
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<tr>
<td>Awake</td>
<td>2</td>
<td>18</td>
<td>2</td>
<td>-</td>
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<tr>
<td>Deep</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>17</td>
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</tr>
<tr>
<td>LMA</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
</tbody>
</table>

2. Remifentanil
3. Airway exchange catheter
Airway Exchange Catheters: Simple Concept, Potentially Great Danger

Benumof, Jonathan L.
UK NEWS

MEDICS COULD HAVE SAVED MAN WHO DIED IN PINKIE OP

By Stephen Wilkie

A MAN who died during “routine” surgery to repair a fractured pinkie could have survived if anaesthetists had simply woken him up, a sheriff has ruled.

Friday April 9, 2010

Gordon Ewing broke his little finger while playing with one of his children and was later treated at Hairmyres Hospital, in East Kilbride, Lanarkshire. However, the injury did not set properly and needed a further operation.

A man who died during “routine” surgery to repair a fractured pinkie could have survived
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**Step 3**
Perform
- Deep Extubation
- Awake extubation
- Advanced Techniques
- Postpone extubation
- Tracheostomy

**Step 4**
Postextubation
Recovery or HDU / ICU
Postextubation care

- Safe transfer
- Handover/communication
- Airway Management
- Observation & monitoring
- General medical and surgical management
- Analgesia
- Staff
- Equipment
- Documentation
This patient has a **LARYNGECTOMY**
and **CANNOT** be intubated or oxygenated via the mouth

Follow the LARYNGECTOMY algorithm of breathing difficulties

**Performed on (date)** ........................................

**Tracheostomy tube size (if present)** ..............

**Hospital / NHS number** ................................

**Notes:**

There may not be a tube in the stoma.
The trachea (wind pipe) ends at the neck stoma

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**Emergency Call:**
- Anesthesia
- ICU
- ENT
- MaFax
- Emergency Team

www.tracheostomy.org.uk

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This patient has a **TRACHEOSTOMY**
There is a potentially patent upper airway (intubation may be difficult)

**Surgical / Percutaneous**

**Performed on (date)** ........................................

**Tracheostomy tube size (if present)** ..............

**Hospital / NHS number** ................................

**Notes:** Indicate tracheostomy type by striking the relevant figure.
Indicate location and function of any sutures.
Laryngoscopy grade and notes on upper airway management.
Any problems with this tracheostomy.

**Emergency Call:**
- Anesthesia
- ICU
- ENT
- MaFax
- Emergency Team

www.tracheostomy.org.uk

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**APPENDIX 4**
Example patient with at-risk airway proforma for ICU

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**ROYAL UNITED HOSPITAL, BATH**
**ICU DIFFICULT AIRWAY FORM**

**PATIENT’S NAME**

**HOSPITAL NUMBER**

**REASON FOR ANTICIPATED DIFFICULT AIRWAY**

**ANTICIPATED PROBLEM**  
- Intubation
- n-intubation after accidental extubation
- n-establishing tracheostomy after displacement
- difficult planned extubation

**PLAN:**

**PLAN A**

**PLAN B**

**PLAN C**

**CONFIRM:**

**DATE**

**Plan A equipment available on ICU**

**Plan B equipment available on ICU**

**Plan C equipment available on ICU**

**Third on-call anaesthetist aware**

**Any additional staff required informed**

**NAME AND GRADE OF DOCTOR (please print):** ..........................................................

**SIGNED:..........................................................................................................................**

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**N/A P:4** Report and findings of the 4th National Audit Project of The Royal College of Anaesthetists
Summary

• Extubation strategy needed for all cases

• Address technical and non-technical factors

• Practice makes perfect..
General Principles

• Recognise the risks
• Plan to avoid difficulty
• Have a back-up plan to deal with difficulty
Difficult Airway Society Guidelines for the management of tracheal extubation

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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DOI: 10.1111/j.1365-2044.2012.07075.x
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**Optimise other factors**
- Location
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- Equipment
- Monitoring

Safe transfer
Handover / communication
\( \text{O}_2 \) and airway management
Observation and monitoring
General medical and surgical management