Airway trauma

Leo Krivskiy
Consultant Anaesthetist
University Hospital
Southampton, UK
Common themes

- Maintenance of spontaneous ventilation
- Intubation under direct vision to avoid the creation of a false passage
- Avoidance of both intermittent positive pressure ventilation and cricoid pressure (the latter for laryngotracheal trauma only) during a rapid sequence induction.
4th National Audit Project of The Royal College of Anaesthetists and The Difficult Airway Society

Major complications of airway management in the United Kingdom

Report and findings
March 2011

Editors
Dr Tim Cook, Dr Nick Woodall and Dr Chris Frerk
NAP4 – recurring themes

- Poor airway assessment.
- Poor planning in the face of potential difficulty.
- Failure to plan for failure.
- Inappropriate use or lack of use of various pieces of airway equipment.
- Poor judgment and a lack of education and training.
Plan A:
Face Mask & Tracheal Intubation
Pre-Oxygenate and Position
MAXIMUM 3 attempts
Remove cricoid pressure if difficult

Plan B:
Maintaining Oxygenation SAD insertion
i-gel
2 attempts
LMA
1 attempt

STOP & THINK
Options:
1. Wake the patient up
2. Intubate via SAD (Aintree)
3. Proceed without intubating
4. Tracheostomy/Cricothyroidotomy

Plan C:
Facemask Ventilation
Can ventilate =>
Reverse paralysis
Wake Up
Can't ventilate:
Ensure paralysis
2 person FMV: If unsuccessful

Plan D:
Emergency Front Of Neck Access
Scalpel – Bougie - Tube
Ask Surgeon to attend
Difficult Airway Society difficult intubation guidelines: overview.

This flowchart forms part of the DAS Guidelines for unanticipated difficult intubation in adults 2015 and should be used in conjunction with the text.

C. Frerk et al. Br. J. Anaesth. 2015;bja.e371
Generic approach
Horizontal, not vertical!

- Where exactly is the problem?
- Awake vs. asleep?
- Is there time for additional investigations?
- What is our strategy (a sum of plans)?
- Difficult anatomy +/- “difficult” physiology?
- What are the capabilities, availability, experience and skill mix of the team?
Potential difficulties

- Mask ventilation.
- Supraglottic airway insertion.
- Endotracheal tube insertion (asleep vs. awake?).
- Transtracheal access (asleep vs. awake?).
# Mechanism of Injury

<table>
<thead>
<tr>
<th>Blunt</th>
<th>Penetrating and Blast</th>
<th>Burns</th>
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</table>
| • High Energy transfer e.g. RTA  
• May form part of complex multisystem trauma | • Knife,  
• Gunshot,  
• Explosions | • Direct heat and steam  
• Thermal injury  
• Smoke Inhalation  
• Electrocution,  
• Corrosive chemicals |
Blunt Maxillofacial Trauma
TRAUMA
Laceration
Obstruction
Haemorrhage
Aspiration

Systematic review of the anaesthetic management of non-iatrogenic acute adult airway trauma
S. J. Mercer, C. P. Jones, M. Bridge, E. Clitheroe, B. Morton, and P. Groom

British Journal of Anaesthesia, 117 (S1): 149–59 (2016)
doi: 10.1093/bja/aew193
Special Issue
Maxfac bleeding problems

- ‘Closed’ / ‘concealed’ injuries
- Multifocal / multisite
- External and internal carotid systems
- Inaccessible vessels
- Difficult to apply direct pressure
- Difficult to splint
- Origin of shock maybe elsewhere - Priority
- Coagulopathy following transfusion
Airway before haemostasis!

- Continuous bleeding could cause obstruction.
- Midfacial soft tissue oedema develops rapidly further compromising intubation.
- Multiple sources of bleeding – local control is usually futile.
Control of Haemorrhage: Nasal Packing

- **Anterior:**
  - BIP on ribbon gauze

- **Posterior:**
  - Foley catheter

- Emergency fixation ?

- Vessel ligation ?
Multi balloon ‘Rhino’
McKesson mouth props
Causes of Airway Compromise in Maxillofacial Injuries: Definitive Airway?

- Reduced GCS
- Panfacial Swelling / Oedema
- Compression of Nasal / Oropharynx
- Haemorrhage
  - Nasal / post nasal
  - Tongue laceration
  - Mandible fracture
- Increased Secretions
- Loose Teeth
- Loss of tongue control due to mandible #
TRAUMAS.S.O.P. - Major Maxillofacial Haemorrhage

Background
Bleeding from extensive midfacial fractures is problematic for two main reasons:

1. The primary threat here is to the airway and this must be rapidly secured prior to any attempts at haemorrhage control which will generally further occlude the mouth, nasal passages and pharynx. Midfacial soft tissue oedema develops rapidly further compromising intubation.

2. Bleeding from maxillofacial injuries is rarely from a single source, more usually from a combination of lacerations to oro / sino / nasal mucosa, bone edges and pterygoid venous plexus posterior to maxilla. Local control with sutures / clips is usually futile.

Policy
1. Assess airway. If conscious, may be improved with patient sitting up.
   Use of high volume suction to protect airway.
2. Consider early definitive airway. Urgently seek experienced anaesthetic help as often extremely difficult to establish. May require cricothyroidotomy access. (refer to airway pathway)
3. Bleep Oral & Maxillofacial team on 452 and request urgent presence of registrar / consultant.
4. Attempt to control mobile midfacial skeleton between intact skull base and mandible:
   i) Placement of bilateral McKesson mouth props between upper and lower molar teeth
   ii) Inter-dental wiring and stabilization of anterior mandibular fractures
   iii) Inter-dental wiring and stabilization of palatal (maxillary) split
5. Nasal packing to achieve tamponade:
   i) Posterior packing with epistat device (such as balloon rhino set) or Foley catheters and gauze swabs to occlude nasopharynx.
   ii) Anterior packing with merocel or ribbon gauze + BIPP
6. Early closure of actively bleeding facial / scalp lacerations with tension sutures and L.A.
7. Standard fluid resuscitation via 2x 14g cannulae.
   Cross match / Code Red as appropriate to response.
8. Correction of coagulopathy if present
One beautiful Saturday evening...

- Level 1 Trauma Call in ED
- Details of further case overheard
- 2 vehicle RTC combined speed 120 mph
- Level 1 Trauma call made in anticipation
Arrival

- 48M driver
- Sat up
- Significant bleeding +++ from nose and mouth. SaO2 92%
- Distressed but compliant
- Tachycardic & Tachypnoeic
Plan?

- Plan A - RSI + ETT. CMac - No
- Plan B - LMA Igel
- Plan C - Surgical airway
  - Who’s going to do it?
- Suction x2
- MILS
Trauma RSI Algorithm

Plan A:
1. Direct
2. Indirect laryngoscopy (C-MAC / Airtraq)
   * Always use the bougie!

Plan B:
1. iGEL LMA, if no chest rise / EtCO
2. BVM + adjuncts, if still no chest rise / EtCO

Plan C:
1. Surgical Cricothyroidotomy
   4 steps: 22 scalpel, forceps, bougie, 6.0 ETT
   Cuffed ETT in the trachea

Oxygenate & Ventilate

Rescue airway

YES!

NO!
Induction

- Pre-O2
- Ketamine & Rocuronium
- Very rapid desaturation
- Blood ++ despite suction
- Oesophageal intubation
- SaO2 40%
- Igel & re-oxygenate
2nd attempt

- CH prepped for Surg Cric
- SaO2 90%
- Successful 2nd attempt at ETT
- Deep breath
Management of haemorrhage

- Bite blocks (urgently from theatre)
- Epistat & Merocell
- Significant reduction in bleeding
- 2U RBC. Tranexamic Acid
- CT
- Theatre
CT findings

- SDH
- Pneumocephalus + frontal lobe contusions
- C1 & 2 unstable #'s
- Bilateral #'s of Frontal bones.
- Comminuted bilateral #'s of Maxillae, Nasal bones, and septum, Rt zygoma, both pterygoid plates
- Rt Clavicle & rib #
- Lung contusions
Theatre

- 4th Jan - Reduction & wiring of facial #’s & ICP bolt. 6U RBC + 4U FFP. Ca2+
- Tracheostomy
- 6th Jan - significant oral/nasal bleeding
- Embolisation of Rt distal internal maxillary artery
- Gastrostomy
- 20th Jan - facial reconstruction
Anaesthetic Trolleys

- 1 per bay
- Kit for RSI, large IV access and invasive monitoring (if appropriate)
- Trauma RSI protocol and checklist attached
- Separate paediatric trolleys
- Difficult intubation trolley x1
Yellow bag drug contents:

- Suxamethonium x 2 amps
- Rocuronium x 2 amps
- Ephedrine
- Phenylephrine
- Adrenaline mini-jet
- Lorazepam (paeds fits)
- Ondansetron
- 100ml saline bag
- 2.7% saline bottle
- Syringes, needles and labels
Small pouch in controlled drug cupboard:

- Propofol (for infusion)
- Fentanyl (10 ml / 500 mcg amp)
- Ketamine (10 mg/ml, 20 ml vial)
- Morphine (10 mg/ml)
- Midazolam (1 mg/ml, 5 ml)
- Thiopentone (500mg powder)

Remember to sign for all drugs used!!
Ketamine – anticipated effects

- Nystagmus
- Hallucination
- Hypertonus
- Salivation / secretions
- Hypertension
- Tachycardia
- Sympathomimetic

**Fentanyl / Ketamine:**
- Wide margin of safety in dosing
- Amnesia
- Excellent analgesia
Indications for RSI

- Actual or impending airway compromise
- Ventilatory failure
- Unconsciousness
- Injured patients who are unmanageable or severely agitated.
- Humanitarian indications
- Anticipated clinical course
Preparation for a trauma RSI in ED

- Automatic and absolutely standard
- Optimise the first attempt at intubation
- ODP: monitoring and rapid standard ‘kit dump’ of equipment
- Prior to induction: Anaesthetist and ODP rapidly ‘talk through’ the pre-RSI checklist and anticipated difficulties
Immediate RSI Checklist

NB – Only to be used for patients requiring immediate definitive airway, where pre-oxygenation is NOT feasible.

**Indication** - confirm immediate RSI required and trauma team leader informed

**Oxygen + Ventilation**
BVM or Waters circuit attached to high flow Oxygen  Check

**Laryngoscope; Mac 3 / 4 blade**  Check

**ETT size ‘x’**  Check

**Bougie**  Check

**iGEL size ‘x’**  Check

**Difficult airway trolley**  Check

**Suction**  Check

**IV in-situ and flushed**  Check

**Drugs**  Fentanyl / Ketamine / Rocuronium (Sux)  Check
Dose: 1:1:1 or 3:2:1?  Check

**EtCO₂**
Sidestream EtCO₂ connected + working or “Easicap”  Check

**BP, HR and SpO₂?**  Check

**GCS/ Pupils – Hypertonic saline / mannitol required?**  Check

**Tension** - Immediate thoracostomies required after RSI?  Check

Attached to side of the ED airway trolley

Trauma ODP to call out list and Anaesthetist to confirm check

PUPILS

Moving limbs??

Contact lenses
Preoxygenation - needle cric first?
Узкопросветная канюля Ravussin
Surgical Cricothyroidotomy
Failed intubation, failed oxygenation in the paralysed, anaesthetised patient

CALL FOR HELP

Continue 100% O₂
Declare CICO

Plan D: Emergency front of neck access

Continue to give oxygen via upper airway
Ensure neuromuscular blockade
Position patient to extend neck

Scalpel cricothyroidotomy

Equipment:
1. Scalpel (number 10 blade)
2. Bougie
3. Tube (cuffed 6.0mm ID)

Laryngeal handshake to identify cricothyroid membrane

Palpable cricothyroid membrane
- Transverse stab incision through cricothyroid membrane
- Turn blade through 90° (sharp edge caudally)
- Slide coudé tip of bougie along blade into trachea
- Railroad lubricated 6.0mm cuffed tracheal tube into trachea
- Ventilate, inflate cuff and confirm position with capnography
- Secure tube

Impalpable cricothyroid membrane
- Make an 8-10cm vertical skin incision, caudal to cephalad
- Use blunt dissection with fingers of both hands to separate tissues
- Identify and stabilise the larynx
- Proceed with technique for palpable cricothyroid membrane as above

Post-operative care and follow up
- Postpone surgery unless immediately life threatening
- Urgent surgical review of cricothyroidotomy site
- Document and follow up as in main flow chart

This flowchart forms part of the DAS Guidelines for unanticipated difficult intubation in adults 2015 and should be used in conjunction with the text.
Just 4 pieces of kit!

- Size 22 Scalpel
- Small curved artery forceps
- Bougie
- Size 6.0 ETT
Blast MF injury = “easy” airway.
Neck trauma

- Penetrating
- Blunt

The approach is the same - visualize before inflating the cuff/IPPV!
Laryngotracheal Trauma

![Diagram of laryngotracheal trauma management]

- **Cooperative patient**
  - Not time critical: Perform diagnostic imaging and formulate plan.
  - Risk vs benefit analysis. Transfer self ventilating to theatre.
  - Perform awake fibreoptic intubation.

- **Uncoperative patient**
  - Not time critical: Perform awake fibreoptic intubation.
  - Time critical: Plan A:
    - RSI
    - Fibreoptic scope assisted direct laryngoscopy or videolaryngoscopy.
    - Avoid cricoid pressure and positive pressure ventilation until tracheal tube cuff inflated distal to lesion.
    - (Tracheal tube placed at introitus of cords and only advance under direct vision via fibrescope)
  - Time critical: Plan B:
    - Emergency tracheostomy
    - Fibreoptic scope to identify distal lesion, tracheal tube advanced under direct vision.

*Systematic review of the anaesthetic management of non-iatrogenic acute adult airway trauma*  
Abnormal gas in prevertebral and pre-tracheal/pharangeal tissues

Normal tracheal air/gas
Management

- Conservative Rx
- Monitored on PICU
- Never intubated or ventilated
- Discharged 2/7 later
- 7 days of antibiotics
2 weeks later

Two weeks later at home
Facial burns
Burns

- High potential for Airway obstruction through swelling (over hours)
- Thermal injury – mostly above vocal cords
- Smoke inhalation – lungs
- Beware facial and neck burns – likely both
Summary

- Maintenance Oxygenation
- Airway Strategy
  - Site
  - Urgency
  - Team experience and equipment
  - ? Awake Trachy
- Human Factors
- Location