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Headline

There were 15 cases reported to NAP₄ where the airway event occurred in the emergency department. Most cases related to difficulty in intubation. Events occurred more frequently out of hours than in anaesthesia cases. Several cases were attended by trainees who lacked the appropriate skills and experience to manage the patients they were presented with. Precipitous care, delayed care, and poor care (failure to use or correctly interpret capnography) all led to avoidable patient harm. Emergency surgical airway was prominent in emergency department reports and was eventually successful in all cases though initial attempts at cannula cricothyroidotomy failed, requiring rescue with a surgical approach. These issues can be summarised in the concept of 'right person, right place, right equipment, right preparation'.

Emergency department airway management is a high-risk area that requires teamwork and a considerable degree of expertise. The majority of the major complications reported to NAP₄ from the emergency department would have been preventable through improved systems, better preparation and good communication. All relevant specialties should therefore plan for likely events, ensuring that those who are called upon to undertake emergency department airway management have the required skills and immediate access to senior support. All emergency department airway practitioners should also be familiar with the environment and the available equipment, which should be standardised to include everything that is likely to be required. Standards of practice, assistance and monitoring (particularly capnography) should conform to nationally accepted guidelines and be identical to operating theatre practice.

What we already know

Approximately 1 in 800 patients attending the emergency department will undergo rapid sequence induction of anaesthesia and tracheal intubation (RSI), and this equates to approximately 20,000 patients every year in the UK.¹ Many more will require simpler airway interventions such as the use of adjuncts, mask ventilation and tracheal intubation without drugs. Airway management, often in an emergency situation, may also be required in the general wards, radiology department and other non-theatre hospital locations: many of the key learning points drawn from the emergency department in NAP₄ will also apply to these environments.

Emergency airway management outside the operating theatre is known to be associated with more frequent problems than routine anaesthesia. Patients with major trauma, though relatively uncommon, merit special consideration in this chapter. They present to UK emergency departments with little or no warning and have acknowledged airway difficulties due to direct airway trauma, haemorrhage into the airway, lung injury limiting pre-oxygenation, physiological compromise (sometimes including critical hypovolaemia) and a requirement to immobilise the neck due to possible cervical spine injury, which is known to increase the incidence of Cormack and Lehane grade 3 and 4 views of the larynx, making intubation even more difficult.²

During elective anaesthesia a failed airway ('cannot intubate, cannot ventilate', CICO) has been reported to occur in 0.01-0.03% of cases.³ Difficult intubation, defined as the need for more than three attempts, has been reported in 1.15-3.8% of elective surgical cases.³ However, the incidence of difficult intubation is significantly higher in emergency departments,⁴ and a failed airway may occur at least ten times more frequently in the emergency department. In the United States, 0.5% of intubations recorded in the National Emergency Airway Registry (NEAR) required a surgical airway.⁵ In a Scottish study, 57/671 (8.5%) of patients undergoing RSI in the emergency department had Cormack and Lehane grade 3 or 4 views at laryngoscopy, and two (0.3%) required a surgical airway.⁶ As a result it is essential that this patient group is managed by experienced individuals who have specific training in emergency airway management outside the operating theatre, and who are able to provide a full range of relevant skills. There must also be a clear system of clinical governance and review to ensure that commonly accepted standards, for example those specified by the Association of Anaesthetists of Great Britain and Ireland, are maintained⁷ and that all the required equipment is immediately available.

Historically, all advanced airway management, regardless of location, has been undertaken by anaesthetists, but this is now changing. In larger hospitals doctors working in critical care (who are usually, but not always, trained in anaesthesia) are often the first to be called for emergency airway management outside the operating theatre. Critical care teams may be more rapidly available if duty

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anaesthetists are occupied in theatre, and a requirement to provide emergency airway management may overlap with the input provided to cardiac arrest and acute intervention or outreach teams. It is also likely that the patients attended by such teams will require critical care interventions beyond airway management, and may be subsequently admitted to the intensive care unit (ICU). However, problems are likely to arise if those attending do not have the expected, or required, airway skills.

Over the past decade emergency physicians in the UK have become increasingly interested and competent in emergency airway management, and 20% of emergency department RSI is now undertaken by this group.¹ This is in keeping with the emergency physician's role at the 'front door' of the hospital, but there are as yet far too few emergency physicians with the relevant skills to be able to provide robust 24-hour emergency airway management in all the UK's emergency departments. Therefore close co-operation with other specialties will continue to be required for the foreseeable future. Increasingly, doctors from critical care and emergency medicine are working together to provide emergency airway management to seriously ill and injured patients, particularly in the larger UK hospitals. The emerging evidence base comparing emergency physicians with anaesthetists in emergency department airway management suggests that there is no significant difference between the two professional groups in terms of intubation success and complications.^{6,8,9} Whilst

this continues to cause controversy in some quarters, the specialty of the person managing the airway is less important than the competencies of that individual and the underlying processes that support effective clinical care and patient safety.

The fact that patients with emergency airway needs often present suddenly and at variable times of the day and night might give rise to the view that it is impossible to plan for this patient group, and that lesser standards of care are acceptable. However, whilst it is impossible to predict exactly where and when such emergencies will arise, the patterns are consistent and predictable when considered over longer periods of time. Any hospital with an emergency department will receive patients with a threatened airway (for example facial injuries in polytrauma or acute stridor), and the frequency of this can be determined from simple audit. Studies have shown that there is often variable, and inadequate, equipment and monitoring available to manage the airway in the emergency department, despite the acknowledged difficulty of this patient group.^{10,11}

It is therefore essential that clinicians from the relevant specialties (usually anaesthesia, critical care and emergency medicine) work together to ensure that robust plans are in place to deal with the emergency airway needs of patients, wherever they arise, and that recognised standards of management and monitoring are maintained. Furthermore, the seniority and experience of available staff must be sufficient to meet the patient's needs. Improved co-operation, planning and oversight of emergency airway care outside the operating theatre will enhance patient safety and outcomes.¹²

Case review

Of the 184 cases reported to NAP4 and meeting inclusion criteria 19 (10%) were as emergency department cases. However, four of these cases were transferred from the emergency department to the operating theatre before any advanced airway management was undertaken. These cases were therefore classified as events related to anaesthesia and are not considered in detail here. The remaining 15 cases (8%) had advanced airway management commenced in the emergency department, and are considered further.

Of the 15 emergency department cases 40% were ASA grade 1–2, 67% male and 80% aged under 60 years. A BMI of $\geq 30 \text{ kg m}^{-2}$ or obese body habitus was recorded in 46% of cases and a BMI of $< 20 \text{ kg m}^{-2}$ or cachexia in 7%. There were 14 adults and one infant. Seven cases occurred during the day, four in the evening and four overnight. The practitioner managing the patient's airway at the time of the reported event is shown in Table 1.



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All cases except three involved attempts at tracheal intubation, the exceptions being facemask anaesthesia for cardioversion and two surgical airways for airway obstruction. In 11 cases (73%) airway management was by an anaesthetist and in eight (53%) a consultant. Anaesthetist involvement fell from 6/7 during the day (0801–1800) to 5/8 out of hours and consultant involvement was 4/7 in-hours and 4/8 out of hours.

Table 1 Specialty and grade of the practitioner managing the airway at the time of the reported emergency department event.

| Grade and specialty | Number |
|---|--------|
| Consultant or Associate Specialist in anaesthesia | 7 |
| Specialist Trainee Year 7 (ST7) in anaesthesia | 1 |
| Specialist Trainee Year 6 (ST6) in critical care (non-anaesthetist) | 2 |
| Specialist Registrar (SpR) in emergency medicine | 1 |
| Specialist Trainee Year 3 (ST3) in anaesthesia | 3 |
| Acute Care Common Stem (ACCS) Trainee in anaesthesia (five months experience) | 1 |

While the most frequent inclusion criterion was a surgical airway (ten cases) the primary problem related to difficult or failed intubation in 14 cases. Of those having an emergency surgical airway two of these patients died, two suffered permanent neurological deficit (one due to the airway event and one severely injured patient whose relationship to the airway event was unclear) and the remaining six were reported as making a full recovery. Of the five patients who did not have a surgical airway established two died as a result of unrecognised oesophageal intubation, two required admission to ICU due to aspiration of gastric contents and one required admission to ICU due to iatrogenic airway trauma. As five patients suffered death or brain damage due to the emergency department airway event the death/brain damage rate is $5/15 = 33\%$. This is higher than in anaesthesia (14%), but lower than for ICU events (61%).

Causal and contributory factors were identified in all 15 emergency department cases. The most frequent causal and contributory factors were patient-related (73% of cases), followed by judgement (57%), education/training (40%) and task (33%). Positive factors were identified in eight cases (53%), the most frequent positive factor being communication (33% of cases). Airway management was assessed as good in 13% (n=2) cases, mixed in 33% (n=5) and poor in 46% (n=7). Airway management was assessed as poor in all emergency department deaths.

Discussion

Right Person

In the four cases managed by junior anaesthetic or ACCS trainees the doctor involved is likely to have lacked the experience to deal with the airway problem they encountered: for example in two reports trainees of this level attempted to undertake RSI in patients with mid-face fractures and blood in the airway. In these situations the trainee anaesthetist may have under-estimated the likely difficulty of the procedure and not sought senior help, even though this was readily available: in both cases a more senior anaesthetist arrived within 1–4 minutes when called during the event, but was not consulted prior to the RSI. These cases suggest poor communication both vertically and horizontally.

Case 1

A previously well young adult presented to the emergency department in the middle of the night with head and maxillofacial trauma. The patient was agitated with a Glasgow Coma Scale of 14 and required intubation to facilitate CT scanning. An unsupervised junior anaesthetist attempted RSI but was unable to intubate or ventilate the patient. Oxygen saturation fell and the patient suffered a cardiac arrest despite attempted needle cricothyroidotomy. A surgical cricothyroidotomy was successful and circulation was restored. A more senior anaesthetist, who arrived within a few minutes of being called, was subsequently able to intubate the patient without difficulty, and a full recovery followed. On review it was clear that the patient could have waited for the more senior anaesthetist to be present, but the junior anaesthetist did not request this and the emergency department staff failed to challenge the decision to proceed.

In view of the acknowledged difficulty of airway management in the emergency department it is important to examine the system of response to emergency department airway emergencies and trauma calls, to ensure that doctors of suitable seniority and experience attend routinely. There was a tendency for junior staff to either undertake advanced airway management precipitously, when additional preparation and the summoning of senior assistance would have been in the patient's interests, or to fail to recognise a deteriorating situation until the patient was critically hypoxic or had entirely lost their airway. These actions suggest inexperience, lack of confidence, poor judgement or a combination of these.

In two other cases the attending airway practitioner was a critical care trainee who appeared to lack the required airway skills. In one case a senior paediatric trainee, working on the Paediatric Intensive Care Unit (PICU), attempted to intubate an infant in respiratory distress but encountered difficulty leading to oesophageal intubation. On review the trainee appeared inadequately experienced

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to anaesthetise the child and did not appreciate the significance of an absent capnography trace. In the other case a senior ICU trainee with novice level anaesthetic experience undertook RSI without using the available capnography leading to oesophageal intubation. In both these cases an apparently avoidable patient death occurred. Again, there was a tendency to underestimate possible difficulty and a failure to seek senior help before commencing advanced airway interventions: in one of these cases a senior anaesthetic trainee was managing another case in the same emergency department resuscitation room, but was not consulted. Where critical care trainees respond to airway emergencies in the emergency department it is essential to ensure that they have the relevant competencies, regardless of their apparent seniority and that there are appropriate support systems.

Case 2

An infant attended the emergency department with respiratory failure, and was anaesthetised by a very experienced trainee from the paediatric intensive care unit (PICU) with very limited anaesthetic experience. Intubation proved difficult, but was believed to have been achieved on the third attempt, despite the absence of a capnography trace. The child desaturated, had two episodes of asystolic cardiac arrest and did not survive. The PICU consultant attended as soon as called, but no anaesthetist or ODP attended because a paediatric cardiac arrest call was not made.

These cases often highlighted a communication gap between the emergency department, anaesthetic and critical care teams. The actual skills of the anaesthetic or critical care trainee may be unknown to the emergency department team, who are likely to presume that the doctor who has arrived to assist them has an appropriate skill set to manage a difficult emergency airway. Similarly, the attending trainee as a visiting 'expert' to the emergency department may find it difficult to admit that they are out of their depth. In one case an emergency department consultant put pressure on an anaesthetic trainee to undertake an immediate intubation in a patient with complex maxillofacial trauma, leading to a failed intubation and surgical airway. It is essential that team leaders in the emergency department establish the skills and role of all team members, and a WHO-style checklist introduction may prove valuable in ensuring staff introduce themselves and their role.¹³

There was one report of a major complication during intubation by an emergency physician. In this case the RSI appeared to proceed uneventfully but required a bougie. A pneumothorax was evident on chest X-ray immediately after intubation and the patient subsequently developed a pneumomediastinum. Endoscopic inspection identified a tracheal tear on the posterior tracheal wall above the carina. The local thoracic surgeon judged that 'the tracheal



tear was likely to be secondary to tracheal intubation', which appears a reasonable assumption. The patient required a prolonged ICU stay. Reported details were incomplete, and whether the trauma was due to poor technique, poor equipment or patient factors is unclear.

Right place

There is an understandable desire by anaesthetists to move a patient with airway compromise to a more familiar environment, such as an operating theatre or anaesthetic room. This may be exacerbated when the airway equipment available in the emergency department is below the standard of that in theatre, however it is not without risk. In two cases a consultant anaesthetist elected to move a patient to theatre in order to perform a surgical airway following a failed intubation in the emergency department, and in at least one case this led to a prolonged period of hypoxia and cardiac arrest. Ideally, patients presenting to the emergency department with acute airway compromise should not be moved to another location until their airway has been safely secured. This requires emergency departments to be equipped and staffed to secure the airway by whatever means may prove necessary, including direct tracheal access. Inevitably the decision to move will depend to some extent on the exact condition of the patient and local circumstances, such as the distance between the emergency department and operating theatre, however in all cases it should be made by a senior member of staff after a careful assessment of the relative risks and benefits. Staff who may be called upon to manage an emergency airway in the emergency department should ensure that they are familiar with the team and equipment available so they are able to function effectively in this environment.

Right equipment

In more than 50% of the emergency department events occurring during attempted intubation capnography was



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either not available, or not used. Given the established recommendations for monitoring during anaesthesia this clearly represents sub-optimal practice.¹⁴ Failure to use capnography led to two unrecognised oesophageal intubations, both of whom died. In one case the lack of a capnograph trace was erroneously attributed to cardiac arrest, when in fact a somewhat attenuated, but typical, trace can be seen in cardiac arrest whilst cardiopulmonary resuscitation (CPR) is ongoing (Figure One). This problem was also identified in events occurring during anaesthesia, and raises the possibility that there is a deficiency in current anaesthetic training on this topic. Understanding this issue is directly relevant to any practitioner called on to manage the airway in the emergency department.

Figure 1 Capnograph trace during cardiac arrest with CPR in progress



In one case no supraglottic airway device was available in the emergency department, whilst in another the poor quality of the intubating bougie was felt to be contributory to a failed intubation. It is therefore essential that all the required equipment is immediately available, and there is a strong argument for standardisation across a hospital so that the same difficult airway equipment is available in every location where anaesthesia may occur.

Right preparation

Many of the problems outlined above could have been effectively prevented by strong teamwork and communication between all the specialties involved in the delivery of emergency airway management in the emergency department. Whilst it is impossible to predict exactly when particular airway problems will present, the fact that they will is certain. It is therefore sensible to agree in advance who will respond, within what time frame, and what approaches will be used for the most common emergency department airway emergencies so that a clear plan of action is in place. These situations will include:

- patient with acute stridor of unknown cause
- patient with a known cause of airway obstruction (e.g. tumour) presenting with increased symptoms
- acute epiglottitis and supraglottitis
- trauma patient with facial injuries and/or haemorrhage into the upper airway
- foreign body impacted in the upper airway
- child with croup or other upper airway narrowing
- child with acute respiratory failure.

Approximately 25% of emergency department intubations are undertaken for trauma,¹ and 4 of the 15 reports (27%) were in trauma patients. The numbers are too small to determine whether trauma patients are disproportionately over-represented in the reported cases, but we were surprised that more reports did not relate specifically to trauma. This may be due to the recognised difficulty of trauma intubations and the formal deployment of trauma teams including an experienced airway practitioner.

Given that 12 emergency department patients had an event related to intubation, and previously published data indicate that approximately 20,000 patients undergo RSI in UK EDs annually, then a major complication rate of 0.06 (6 cases per 10,000 RSIs) is implied. However, it seems highly likely that emergency department complications have been under-reported for the reasons discussed elsewhere in this report. In addition, an emergency department LR was identified in only half of all eligible hospitals, though most major complications occurring in the emergency department would be expected to come to the attention of LRs in anaesthesia and critical care.



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| EMERGENCY INDUCTION CHECKLIST | | | |
|--|---|--|--|
| Prepare Patient | Prepare Equipment | Prepare Team | Prepare for difficulty |
| <ul style="list-style-type: none"> <input type="checkbox"/> Is preoxygenation optimal? <ul style="list-style-type: none"> <input type="checkbox"/> $\text{ETO}_2 > 90\%$ <input type="checkbox"/> Consider CPAP <input type="checkbox"/> Is the patient's position optimal? <ul style="list-style-type: none"> <input type="checkbox"/> Consider sitting up <input type="checkbox"/> Can the patient's condition be optimised any further before intubation? <input type="checkbox"/> How will anaesthesia be maintained after induction? | <ul style="list-style-type: none"> <input type="checkbox"/> What monitoring is applied? <ul style="list-style-type: none"> <input type="checkbox"/> Capnography <input type="checkbox"/> SPO_2 probe <input type="checkbox"/> ECG <input type="checkbox"/> Blood pressure <input type="checkbox"/> What equipment is checked and available? <ul style="list-style-type: none"> <input type="checkbox"/> Self-inflating bag <input type="checkbox"/> Working suction <input type="checkbox"/> Two tracheal tubes <input type="checkbox"/> Two laryngoscopes <input type="checkbox"/> Bougie <input type="checkbox"/> Supraglottic airway device <input type="checkbox"/> Do you have all the drugs required? <ul style="list-style-type: none"> <input type="checkbox"/> Consider ketamine <input type="checkbox"/> Relaxant <input type="checkbox"/> Vasopressor | <ul style="list-style-type: none"> <input type="checkbox"/> Allocate roles; <ul style="list-style-type: none"> <input type="checkbox"/> Team leader <input type="checkbox"/> First Intubator <input type="checkbox"/> Second Intubator <input type="checkbox"/> Cricoid Pressure <input type="checkbox"/> Intubator's Assistant <input type="checkbox"/> Drugs <ul style="list-style-type: none"> <input type="checkbox"/> MILS (if indicated) <input type="checkbox"/> Rescue airway <input type="checkbox"/> How do we contact further help if required? | <ul style="list-style-type: none"> <input type="checkbox"/> If the airway is difficult, could we wake the patient up? <input type="checkbox"/> What is the plan for a difficult intubation? <ul style="list-style-type: none"> <input type="checkbox"/> Plan A: RSI <input type="checkbox"/> Plan B: e.g. BMV <input type="checkbox"/> Plan C: e.g. ProSeal LMA <input type="checkbox"/> Plan D: e.g. Front of neck <input type="checkbox"/> Where is the relevant equipment, including alternative airway? <ul style="list-style-type: none"> <input type="checkbox"/> DO NOT START UNTIL AVAILABLE <input type="checkbox"/> Are any specific complications anticipated? |

This Checklist is not intended to be a comprehensive guide to preparation for induction

RTIC Severn

Figure 2 Example checklist for use prior to emergency department intubation.

Many of the emergency department events (12/15) occurred during attempted intubation. Case review identified variously: precipitous actions, the wrong personnel, poor communication, incomplete back-up plans, lack of equipment and omission of vital monitoring. A simple checklist based around preparation of the patient, equipment/drugs, staff and for potential difficulty can identify potential problems in a very short time and improve patient safety. An example of such a checklist is shown in Figure 2.

Learning points and recommendations

Recommendation: Emergency department airway management should be based on the concept of the right person, right place, right equipment and right preparation.

Recommendation: Good and ongoing communication between senior clinicians in the emergency department, anaesthesia, critical care, ENT and other relevant specialties is essential in planning for, and managing, the emergency airway problems that present to the emergency

department. Consideration should be given to designating consultant leads from each involved specialty to agree and oversee the management of emergency airway problems presenting to the emergency department.

Recommendation: Agreed plans should be in place for the management of all common and predictable emergency department airway emergencies.

Recommendation: Robust processes should be established to ensure the prompt availability of appropriately skilled and senior staff at any time of the day or night to manage the airway within a reasonable timeframe.

Recommendation: All practitioners who may be called upon to manage airway emergencies in the emergency department must have the required skills and experience, with immediate access to senior supervision. This is particularly important for trainees in emergency medicine and critical care.

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Recommendation: In cases of airway compromise it is generally preferable to secure the airway before moving the patient out of the emergency department, but local considerations apply. Any decision to move a patient with a threatened airway should be made by a senior clinician.

Recommendation: All of the equipment and monitoring that may be required, along with a properly trained and skilled assistant, should be immediately available in the emergency department. There is a strong argument for the standardisation of all airway equipment, including difficult airway and rescue devices, across a hospital or group of hospitals.

Recommendation: Staff who may be required to manage airway emergencies in the emergency department should be familiar with the environment and available equipment.

Recommendation: Joint training of Emergency Physician and Anaesthesia/ICU staff is recommended, focusing on the anticipated clinical presentations. Training should include use of the airway equipment available in the emergency department, failed intubation and emergency surgical airway techniques. It should also identify the point at which trainees reach the limit of their expertise and mechanisms for summoning more experienced clinicians. Such training is likely to include simulation and team training.

Recommendation: A checklist should be used for all emergency department intubations. Such a checklist might usefully identify preparation of the patient, equipment/drugs and team, and preparation for difficulty.

Recommendation: Capnography should be used routinely in every emergency department intubation and every emergency department anaesthetic. A somewhat attenuated, but typical, capnograph trace will be present during cardiac arrest if the tracheal tube is correctly placed and cardiopulmonary resuscitation (CPR) is ongoing.

Recommendation: There should be regular audit of emergency department airway management, examining any problems or adverse events that occur.

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