

# Major complications of airway management in the UK

## The Fourth National Audit Project.

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### Introduction

The Fourth National Audit Project (NAP4) collected data on airway management techniques in use throughout the UK, and case reports of adverse incidents (inclusion criteria **table 1**) occurring in the Emergency Department, ICU or during anaesthesia over one year (1,2,3,4).

Inclusion Criteria An airway problem resulting in;
1/ Death
2/ Brain damage
3/ Emergency surgical airway (ESA)
4/ Unanticipated ICU admission

**Table 1**

Major Airway Complications during Anaesthesia Reported in the UK	
Death	1:180,000
Death or Brain damage	1:151,000
ESA	1:50,000
Any major complication	1:22,000

**Table 2**

### Airway complications during anaesthesia

The project received 184 reports in total; 133 came from anaesthesia which included 16 deaths, 3 patients with persistent neurological deficit and 58 attempted surgical airways. The outcomes recorded from the ICU and ED tended to be more adverse. The point incidence of complications during anaesthesia is shown in **table 2**. It is unlikely that every case meeting the inclusion criteria was actually reported to the project and the incidence of one death from an airway problem per 180,000 general anaesthetics represents an underestimate. On average 2.9 anaesthetists were involved in each event reported, therefore, the risk of an anaesthetist encountering a complication meeting each inclusion criterion is 3 times higher than expected for a patient.

### Findings and recommendations

The main benefits of this project come from the systematic and detailed analysis of the individual reports. In one-third of cases the care provided was considered to be poor, but in one-fifth, care was considered to be good and in the majority of cases there were elements of both good and poor care.

### Airway management strategy

An airway management strategy requires a logical sequence of plans or techniques aimed at; maintaining oxygenation, preventing aspiration and avoiding airway trauma. In some cases there was little anticipation of the possibility of failure, some anaesthetists followed plans which were poorly suited to the patient's clinical problem and in others plans failed where equipment or personnel were not available when needed.

### Airway assessment

The cornerstone of airway management is assessment which was often poorly performed or not recorded. It is important to identify those patients who are incompatible with standard airway management algorithms and poor performance was evident in this area. Airway difficulty is increased by problems with; 1) mask ventilation, 2) LMA insertion, 3) tracheal intubation, 4) direct tracheal access. In addition, an assessment of the aspiration risk and of a patient's ability to co-operate is also required to develop the safest strategy.

### Aspiration

This was the commonest cause of death reported to NAP4 and the assessment of aspiration risk was found to be poor.

In some patients at very high risk of regurgitation and aspiration, routine precautions such as gastric drainage, rapid sequence induction, or tracheal intubation were omitted. Some patients with intestinal obstruction were managed with no precaution against aspiration. In patients at lesser risk, steps to reduce aspiration by pharmacological means or by the use of a 2<sup>nd</sup> generation supra-glottic airway (SAD) were not taken. Trauma and opiate medication may lead to gastric stasis and regurgitation. Where this was not considered or it was ignored, aspiration occurred.

## Supra-glottic airway devices

Deaths were reported where SADs were used inappropriately, for example in morbidly obese patients in the lithotomy position, or in patients at high risk of aspiration. SADs were employed to avoid tracheal intubation in some patients with an anticipated difficult airway with no obvious backup plan when the device was displaced. SADs may act as a useful conduit for tracheal intubation which was most successful using a fibroscope and an Aintree catheter. If this technique had been used in some patients instead of prolonged ventilation via SAD cases of aspiration, fatal airway obstruction and surgical airways might have been avoided.

## Known or anticipated difficult airways

*Awake intubation* and awake tracheostomy were under-utilised; several patients with obvious potential difficulty might have been protected by the use of awake intubation rather than general anaesthesia. In others, where awake fibreoptic intubation (AFOI) was attempted the airway became obstructed; notably sedation led to complications with AFOI. Awake intubation may fail, its safety relies upon the fact that spontaneous ventilation is maintained and the option of regrouping or abandonment is available. A plan in the event of failure should be decided and communicated at the outset. Over-sedation can result in airway obstruction or central apnoea, placing the patient in a perilous position, at an even greater risk than if general anaesthesia had been induced after thorough pre-oxygenation. Complicated sedation techniques or difficult patients are best managed by a 2<sup>nd</sup> anaesthetist with sole responsibility for maintaining oxygenation and sedation. Unnecessary selection of the nasal route led to failures of awake intubation, as in these patients either the tracheal tube would not pass through the nose, or excessive bleeding led to airway compromise. All departments of anaesthesia should ensure patients have access to skilled awake intubation if needed and provision should be made to support anaesthetists who need assistance in providing this standard of care.

*Regional anaesthesia* could have prevented some serious complications which developed under general anaesthesia, however, loco-regional anaesthesia needs to be carefully conducted. Several patients with an anticipated difficult airway ran into problems when it was necessary to convert loco-regional anaesthesia to general anaesthesia. Intraoperative conversion to GA is higher risk than gaining control of the airway before starting surgery. For regional anaesthesia in patients with a known difficult airway a clear plan for block failure should be formulated and communicated with the whole theatre team. The quality of the block must be confirmed before starting and a competent surgeon capable of performing the surgery in the time available is needed.

*Supra-glottic airway devices* were used as an alternative to tracheal intubation in some patients with anticipated or unexpectedly difficult airways. Deaths occurred in such patients where a device became displaced or obstructed and rescue techniques failed.

## Abnormal BMI

Patients with high or low BMI were disproportionately represented in NAP4 reports. Patients of normal habitus who were not underweight or obese accounted for relatively few reports. Obese and morbidly obese patients were respectively reported to NAP4 twice and four times as often as would be expected from their prevalence in the UK national population. The options for airway rescue need to be carefully evaluated. Where rescue techniques are assessed as difficult or problematic, awake intubation or regional anaesthesia should be considered. Morbidly obese patients require more time for assessment and adequate discussion of the options for anaesthesia. Planning for operations, including minor surgery, must recognise the additional time and resources needed to safely assess and to anaesthetise the morbidly obese patient.

## Head and neck surgery

Patients with head & neck pathology frequently developed airway obstruction and carried the highest risk of CICV. Pre-assessment was considered to be poor as was planning and communication about this group and this applied at both induction and to the recovery period leading to adverse outcomes. Airway tumours, particularly those producing airway obstruction, should be assessed with airway radiological investigations and supplemented by nasendoscopy and a team approach taken if necessary with prior group discussion. Awake tracheostomy was apparently under-utilised but could have prevented some serious complications, particularly in those patients with severe airway obstruction and stridor.

## Emergence and recovery

Approximately one-quarter of complications occurred at the end of anaesthesia. All cases resulted in airway obstruction with operations in or around the airway, particularly involving bleeding commonly featured in this group. Anticipation of problems was poor which was most surprising when difficulty had already been encountered at induction. Some patients were well managed by controlled extubation in the operating room followed by a period of observation prior to transfer to PACU but better communication of problems to recovery staff could have improved care. In those patients with a difficult airway who are unsuited to routine rescue techniques, post-operative instructions on what to look for, a plan of management, equipment needed and location of skilled personnel should be communicated to recovery or ICU staff.

Post obstructive pulmonary oedema occurred in 13 (10%) anaesthesia cases reported to NAP4 and this was associated with one death. A number of these cases could have been prevented by the use of a bite block or 2<sup>nd</sup> generation SAD to prevent airway occlusion by a patient biting down on an artificial airway.

## Airway trauma

Repeated attempts at tracheal intubation led to the development of CICV. Several cases of failed tracheal intubation followed a recent difficult but successful tracheal intubation where swelling may have complicated their management. Previous difficulty by a trainee was ignored by seniors who then ran into problems themselves. Airway trauma at induction, if followed by a period of extreme Trendelenburg, led to cases of postoperative airway obstruction necessitating intubation or tracheostomy. High pressure oxygenation via an airway exchange catheter resulted in bilateral pneumothoraces. One tracheal tear and a case of severe airway haemorrhage were attributed the blind use of a bougie.

## Capnography

Capnography was used in all anaesthesia cases but several deaths followed when an absence of detectable CO<sub>2</sub> was erroneously attributed to cardiac arrest, this delayed recognition of tracheal tube obstruction or oesophageal intubation. An absence of detectable CO<sub>2</sub> indicates non-ventilation of the lungs due to tracheal tube misplacement or total airway obstruction.

## Emergency surgical airway

NAP4 reviewed 80 cases involving an emergency surgical airway, 58 during anaesthesia. Needle crico-thyroidotomy was favoured by anaesthetists of which 60% failed with fine bore techniques having the highest failure rate. The opportunities for failure are multiple, including misplacement, device malfunction and misuse. Surgical tracheostomy or crico-thyroidotomy carried the highest success rate. Insertion of a supra-glottic airway or administration of a muscle relaxant might have enabled pulmonary ventilation in some patients and these should always precede an emergency surgical airway in the management of CICV.

## ICU and ED reports

Of the 184 reports 36 came from ICU and 15 from emergency departments (ED). Using appropriate denominator data for the ED (5) and ICU (6) airway management interventions were respectively 36 times and 56 times more likely to result in major complications than during anaesthesia.

## ICU

Displaced tracheostomy tubes and to a lesser extent displaced tracheal tubes were the greatest cause of morbidity and mortality in ICU patients. In the cases reported, planning for the management of airway problems was poor, most notably in those patients who were admitted for the management of prior airway problems and in those patients on the ICU in whom airway management problems had already occurred. All patients dependent on an artificial airway should have a re-intubation plan with the appropriate equipment immediately available.

Continuous capnography in the ICU would have facilitated the earlier detection of some airway events or recognition of failed rescue attempts. The absence of capnography contributed to 70% of ICU related deaths.

## Emergency department

Inexperienced practitioners, unfamiliar or absent equipment and poor access to skilled help were considered to be factors contributing to complications. In the Emergency Department oesophageal intubations were missed due to failure to use capnography.

## Conclusion

Airway management in the UK could be safer. The problems reported in the UK may occur in other countries, even in those with better training, equipment, or skills and complacency is a serious threat to safer airway management. Throughout their careers most anaesthetists and in particular those who work in ICU or emergency medicine, can have a real expectation to be involved in multiple airway events of the type collected by the NAP4 project.

## More Information

The full 220 page report can be freely downloaded from the Royal College of Anaesthetist's web-site at the address provided in reference 3.

Powerpoint presentations made for the release of the NAP4 report can be viewed or downloaded from (<https://rayzume.com/NIAA/article.php?newsid=515>) accessed 29/07/2014.

### References:

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