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4th National Audit Project of
The Royal College of Anaesthetists and The Difficult Airway Society

Major complications of airway management in the UK

EMBARGOED UNTIL 23.30 hrs (BST) Tuesday, 29 March 2011

Major report shows obese patients have double the risk of airway problems during an anaesthetic
Study also shows routine monitoring of breathing could reduce deaths in intensive care

A major UK study on complications of anaesthesia has shown that obese patients are twice as likely to develop serious airway problems during a general anaesthetic than non-obese patients. 'The airway' means the air passages from the outside world to the lungs, which must be kept open to keep the patient alive. The study also shows that the use of a simple breathing monitor, called a capnograph, could significantly reduce deaths and brain damage from such problems in intensive care units (ICUs); it found that absence of a capnograph contributed to 74% of deaths from these events in ICUs during the study.

The report, which is published in two parts online today in the *British Journal of Anaesthesia* [1], is the result of a year-long prospective study by the Royal College of Anaesthetists (RCoA) and the Difficult Airway Society and will be presented to a meeting of the RCoA on Wednesday 30 March. The full report is available on the RCoA website on the same day. The project, which identified that 2.9 million general anaesthetics are given in the UK each year, monitored all major complications of airway management that occurred in these patients and in ICUs and in emergency departments throughout the UK in 2008-2009. It studied only events serious enough to lead to death, brain damage, ICU admission or urgent insertion of a breathing tube in the front of the neck.

The report has several findings and recommendations; but those on obesity and the monitoring of breathing are among the most striking.

Obesity
In addition to the two-fold increased risk of obese patients developing serious airway problems during an anaesthetic, the study also found that patients with severe obesity [2] were four times more likely to develop such problems. In addition, obese patients were more likely to die if they sustained airway complications in ICU.

Some obese patients died from complications of general anaesthesia whilst undergoing procedures that could have been performed under local or regional anaesthesia (where only part of the patient's body is anaesthetised). In some cases this alternative appeared not to be considered.

Dr Nick Woodall, Consultant Anaesthetist at the Norfolk and Norwich Hospital (Norwich, UK), and an author of the report says: "Our findings show that patients who are obese have twice the risk of major airway problems during anaesthesia, compared to non-obese patients. In the very obese this risk is even higher. The report is important for patients and anaesthetists alike. The information will enable obese patients to be better informed about the risks of anaesthesia and to give informed consent. We hope our findings will encourage anaesthetists to recognise these risks and choose anaesthetic techniques with a lower risk, such as a regional anaesthesia, where possible, and also prepare for airway difficulties when anaesthetising obese patients."

Monitoring breathing in intensive care units

Airway problems were more likely to result in death in patients sedated on ICUs than if they occurred during anaesthesia for surgery. Half of the reports of events on ICUs described a patient death from the complication, whereas 12% died when the complication occurred during anaesthesia. Of the events reported from ICU 61% led to death or brain damage, compared to 14% of events during anaesthesia.

The most important finding was that the absence of a breathing monitor (capnograph) contributed to 74% of airway-related deaths reported from ICUs. The authors say that if the monitor had been used it would have identified problems at an earlier stage and so could have prevented some of the deaths altogether. The capnograph, which detects exhaled carbon dioxide, is used almost universally in anaesthesia but only sporadically in ICUs. Several authors and organisations have recommended that it should be used routinely in ICUs but, at present, this does not appear to be happening.

Dr Tim Cook, a Consultant in Anaesthesia and Intensive Care at the Royal United Hospital, Bath (Bath, UK), and one of the report authors, says: "The findings of this report indicate that when airway problems arise in this group of sick patients the consequences are often very severe. The report makes several recommendations to improve the safety of airway management in the ICU. The single most important change that would save lives is the use of a simple breathing monitor, which would have identified or prevented most of the events that were reported. We recommend that a capnograph is used for all patients receiving help with breathing on ICU; current evidence suggests it is used for only a quarter of such patients. Greater use of this device will save lives."

Although the poor physical condition of patients needing to be in ICU possibly accounted for some the difference in outcome, the report identified several other causes:

- patients on ICU who are at risk of airway problems were less likely to be identified (and their management changed) than when undergoing anaesthesia;
- the range of equipment available to manage patients with difficult airways is often less extensive in ICU compared to patients being anaesthetised in operating theatres;
- changes in training mean that the junior doctors looking after patients out of hours on ICU may have little experience in the management of difficult airway problems;
- rescue techniques (procedures performed to resolve a problem with the airway) are less likely to be successful in ICU compared to during anaesthesia.

Dr Cook says: "Despite the finding of this project, it is clear that anaesthesia remains extremely safe. The report estimates that a life-threatening airway complication occurs in less than one in 20,000 general anaesthetics (0.005%) and death in approximately one in 180,000 anaesthetics. Most patients who had complications that were reported to this project had identifiable risk factors such as obesity or head and neck cancer; these patients are at a much higher risk of airway complications than healthy patients undergoing anaesthesia and surgery."

Dr Peter Nightingale, President of the RCoA, comments: "I believe this report highlights areas of critical concern for all doctors involved in maintaining the airway of patients receiving anaesthetics or in intensive care units. The report provides a specific insight into the high risks and complications associated with airway management and obese patients which should act as a focus for all healthcare professionals treating such patients."

Dr Ellen O'Sullivan, President of the Difficult Airway Society, adds: "The Difficult Airway Society welcomes the publication of this important study which emphasises the critical importance of high quality airway management in providing safe care of patients during anaesthesia and in intensive care. The report shows that in a small number of cases there is room for improvement and it is important that as a profession we listen to these lessons."

- ENDS -

[1] "Major complications of airway management in the UK: results of the 4th National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 1 Anaesthesia." ***British Journal of Anaesthesia.*** **doi:10.1093/bja/aer058**
and
Major complications of airway management in the UK: results of the 4th National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 2 Intensive Care and Emergency Departments. ***British Journal of Anaesthesia.*** **doi:10.1093/bja/aer059**

[2] Obesity is defined as a body mass index of >30 and severe (morbid) obesity as >40. Body mass index is calculated as weight in kilogram / (height in metres squared): and expressed in the units kg/m²

Notes for editors
The full report is called:
"4th National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society: Major complications of Airway Management in the UK."
It will be published by the Royal College of Anaesthetists on 29 March 2011 at 23.30 hrs (BST) and will be available on the website at http://www.rcoa.ac.uk/nap4. This project was widely supported by a large number of medical organisations, medical indemnity organisations and by the Chief Medical Officers of all four countries in the UK.

The website of the lead organisations are
Royal College of Anaesthetists http://www.rcoa.ac.uk and http://www.rcoa.ac.uk/nap4
Difficult Airway Society http://www.das.uk.com/ and http://www.das.uk.com/nataauditproject

Other partners include
National Patient Safety Agency http://www.npsa.nhs.uk/
Intensive Care Society http://www.ics.ac.uk/
College of Emergency Medicine http://www.collemergencymed.ac.uk/

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Technical details

The airway and airway management

When doctors talk about the airway they mean the breathing passages from the outside world to the lungs. These are the nose and mouth, the pharynx (throat), the larynx (voicebox), the trachea (windpipe) and bronchi (lung passages). These passages enable oxygen in air to enter the lungs and carbon dioxide to leave the body. The airway must remain open at all times or the patient will suffocate in a few minutes. When a patient is unconscious there is a tendency for the airway to collapse (obstruct) as the muscles keeling the airway open stop working.

When a patient is anaesthetised, the anaesthetist (a specialised doctor) keeps the airway passages open by inserting a tube (there are various sorts) into the airway. One of the important roles an anaesthetist has during anaesthesia and surgery is to monitor that the airway is clear and that oxygen levels are normal: monitors assist the anaesthetist and use of a capnograph is routine.

In ICU many patients need help with their breathing (ventilation). The patient is usually sedated rather than anaesthetised and a tube is inserted into the trachea via the mouth and larynx (a tracheal tube). Some patients have a hole made in the front of their neck (tracheostomy) and a tube placed directly into the trachea (tracheostomy tube). The tube (artificial airway) stays in place until the patient has recovered enough for it to be removed.

Airway complications

Major airway complications usually fall into one of three categories

i) Obstruction. If the airway becomes blocked (obstructed) at any level the passage of oxygen into the lungs and carbon dioxide out cannot occur. Obstruction can occur due to collapse of airway muscles or if an anaesthetic breathing tube becomes displaced or blocked by secretions, blood or a 'foreign body'.

ii) Trauma. The airway may be injured by anaesthetic or surgical procedures or by a disease process. This leads to swelling and may cause obstruction. Airway trauma ranges in severity form trivial to life-threatening.

iii) Aspiration. If the patient inhales stomach contents or blood into the airway this can cause inflammation of the lungs or airway obstruction.

Each of these complications may lead to low oxygen levels (hypoxia- a form of suffocation) and if not rapidly corrected it will lead to brain and heart damage then death.

This project examined airway complications leading to

- Death,
- Brain damage,
- Admission to ICU or
- The need to insert a tube through the neck into the windpipe as an emergency.

The Capnograph (breathing monitor)

When we breathe out we exhale carbon dioxide (a waste product). A capnograph is a breathing monitor that detects carbon dioxide in exhaled breath. When a capnograph detects carbon dioxide it indicates (breath by breath) that the patient is breathing through a clear airway and that, if the patient has a breathing tube, this is not displaced or blocked. The capnograph can therefore be used to detect problems with the airway as soon as they occur. Their use is almost universal (it is an expected standard of care) during anaesthesia but is much less common in ICU. The link (http://www.icu-usa.com/tour/procedures/capnography.htm) gives a clear description of capnography and shows some pictures of the monitored waveforms.

Introduction of capnography to more ICUs would require modest cost and would require training of nurses and those doctors who are not familiar with its use.

Critically ill patients on ICU
Patients in an ICU are always very sick and have reduced physical reserves. They are therefore very vulnerable to breathing or airway problems. The report highlights that the Intensive Care Unit is the place where earlier detection of problems could save lives. There are approximately 2500 ICU beds in England and Wales and 1500 High Dependency Unit beds.

Other findings
The most frequent complication leading to death for an airway complication during anaesthesia was inhalation of stomach contents. This is a well recognised problem and in the vast majority of anaesthetics this is prevented, however in some reported cases the appropriate preventative measures were not taken.

While good teamwork and communication were evident in many cases the outcome of some events might have been improved by better assessment, planning, teamwork, communication, clear thinking and following published guidelines. These are collectively termed 'human factors'.

Useful individual cases for journalists to refer to–
Due to the confidential nature of the project is it is not possible to identify patients or families of patients affected by the airway complications reported to NAP4. However there have been two cases of such events that have been prominent and are in the public domain. These cases, as well as having a major impact on the families of the patients have been considered in depth by the anaesthetic profession. Neither case was part of the NAP4 project.

Elaine Bromiley
In April 2005 Elaine Bromiley died after there was difficulty in managing her airway after she was anaesthetised for routine nasal surgery. An independent report on the events around the time of her death is available at http://www.chfg.org/wp-content/uploads/ElaineBromileyAnonymousReport.pdf

After her death, Elaine's husband Martin Bromiley, who is an airline pilot interested in human factors, established the Clinical Human Factors Group. This group (http://www.chfg.org/) has the aim of increasing awareness of the importance of human factors in safety in medicine.

Gordon Ewing
In May 2006 Gordon Ewing died after there was difficulty in managing his airway after he was anaesthetised for routine surgery to his little finger. A fatal accident inquiry report by Sheriff Ruxton is available at http://www.scotcourts.gov.uk/opinions/2010FAI15.html

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Statement by Mr Martin Bromiley, husband of Elaine Bromiley
25 March 2011

Elaine Bromiley, a healthy young Mum, died after problems occurred during attempted anaesthesia before a routine operation on 29 March 2005. A well equipped operating theatre and a professional, experienced and diligent team who possessed a perfect technical skill set were overtaken by an unanticipated emergency. There were apparent failings in situation awareness, leadership, judgement and team working; as well as confusion over the use of equipment. Guidelines to cope with such problems were not followed; but apparently neither were the team rehearsed in such guidelines. These were not bad clinicians, just people who lacked insight into such situations and factors.

Since the death of my late wife the anaesthetic community have worked hard to learn the lessons that are inevitable in such a tragic case. NAP 4 is an excellent example of how broader lessons can be learnt when insightful professionals are given the freedom to honestly and critically review their performance.

Elaine's case highlights that even when the risk factors are relatively low, clinicians can find themselves dealing with an unanticipated emergency which can overtake even the best people if they are not mentally prepared and trained to deal with the various human factors that can lead to disaster. The report rightly highlights the role of human factors such as judgement, communication, equipment standardisation and systemic issues as critical factors in moving the fine line between success and failure. But once clinicians understand not only their patient but themselves and the system around them they will be better prepared for what may follow.

The report also demonstrates that many of the anaesthetic community already understand human factors and have been able to achieve heroic saves despite the odds being stacked against them. It is my sincere hope the NAP 4 and follow-on work will enable a broader clinical community to make disaster much less common and heroic saves much less needed.

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