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SPECIAL ARTICLES

Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 1: Anaesthesia†

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Background. This project was devised to estimate the incidence of major complications of airway management during anaesthesia in the UK and to study these events.

Methods. Reports of major airway management complications during anaesthesia (death, brain damage, emergency surgical airway, unanticipated intensive care unit admission) were collected from all National Health Service hospitals for 1 yr. An expert panel assessed inclusion criteria, outcome, and airway management. A matched concurrent census estimated a denominator of 2.9 million general anaesthetics annually.

Results. Of 184 reports meeting inclusion criteria, 133 related to general anaesthesia: 46 events per million general anaesthetics [95% confidence interval (CI) 38–54] or one per 22 000 (95% CI 1 per 26–18 000). Anaesthesia events led to 16 deaths and three episodes of persistent brain damage: a mortality rate of 5.6 per million general anaesthetics (95% CI 2.8–8.3): one per 180 000 (95% CI 1 per 352–120 000). These estimates assume that all such cases were captured. Rates of death and brain damage for different airway devices (facemask, supraglottic airway, tracheal tube) varied little. Airway management was considered good in 19% of assessable anaesthesia cases. Elements of care were judged poor in three-quarters: in only three deaths was airway management considered exclusively good.

Conclusions. Although these data suggest the incidence of death and brain damage from airway management during general anaesthesia is low, statistical analysis of the distribution of reports suggests as few as 25% of relevant incidents may have been reported. It therefore provides an indication of the lower limit for incidence of such complications. The review of airway management indicates that in a majority of cases, there is 'room for improvement'.

Keywords: airway; audit; brain damage; complications; cricothyroidotomy; death; emergency department; intensive care, tracheostomy

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Airway management is fundamental to safe anaesthetic practice and in most circumstances is uncomplicated, but it has been recognized for many years that complications of airway management occur with serious consequences.[1 2] Good-quality information on the frequency and nature of major adverse events related to anaesthetic airway management is incomplete. Litigation-based analyses add some insight into the severity of such events and have driven changes in practice.[3–6] These indicate that airway and respiratory complications leading to litigation are a small proportion of all claims against anaesthetists but are associated with notably high rates of death and brain damage, high rates of 'less than appropriate care', and high costs. Owing to the complexity of the relationship between complications and litigation, and the lack of denominators, they do not add information about prevalence or incidence of complications.[7 8] Analyses of critical incident reports in the UK have also added useful information, but these reports largely focus on minor incidents and are likely to miss a considerable proportion of major events.[9]

Knowledge of the incidence of such complications should be an important component of clinical decision-making, risk management, and the consent processes. Information on serious and common complications should guide the specialty into appropriate areas for research by demonstrating areas in which our current practice or performance can improve.

† This article is accompanied by the Editorial.

The Fourth National Audit Project of the Royal College of Anaesthetists (RCoA) and the Difficult Airway Society (DAS) (NAP4) was established to estimate the incidence of major complications of airway management in NHS hospitals in the UK and to perform a quantitative and qualitative analysis. Three areas of clinical practice were identified and considered separately:

- airway management during anaesthesia;
- airway management in the intensive care unit (ICU);
- airway management in the emergency department.

This paper, which reports complications of airway management during anaesthesia, and the accompanying paper, which reports on complications during airway management in ICU and the emergency department, present the major results of the project.[10] For reasons of space, this paper is limited to an overview of events that were reported to the project and their quantitative analysis. It should be read in conjunction with the full report of the project available on http://www.rcoa.ac.uk/index.asp?PageID=1089.

Methods

A two-part project was devised using methods based on the Third National Audit Project of the RCoA.[11] First, a census of airway management techniques used in the UK National Health Service (NHS) provided information on anaesthetic activity and airway management techniques in current use (for denominator information); secondly, a registry of the major complications of airway management over a 12 month period recorded details of serious adverse events (for numerator information). Discussions with the National Research Ethics Service indicated that ethical approval was not required. The project was examined by the Patient Information Advisory Group of the Department of Health and the project design was assessed to ensure current standards of patient confidentiality were met. There was wide consultation with other specialist societies and organizations with an interest in this area of clinical care.

Using surface mail, e-mail, and telephone, the anaesthetic department in every NHS hospital in the UK was contacted and invited to participate in the project and to nominate a local reporter who would act as the point of contact for the audit, co-ordinate the census of current activity, and assist with the second phase during which reports of individual serious complications were to be submitted. Data were not sought from private hospitals or Independent Sector Treatment Centres. However, data were collected from treatment centres attached to NHS hospitals.

A detailed written explanation of the NAP4 project and the purpose of the census were placed on both the DAS and RCoA websites. Data collection forms and information sheets were also made available for downloading. The project was very widely advertised in UK journals of anaesthesia, by specialist societies (see Supplementary Appendix) and by a poster campaign to promote awareness and encourage participation. Reminders were sent to hospital local reporters approximately every 6–8 weeks throughout the data collection period.

Part 1: census of clinical activity (denominator data)

A detailed description of the census phase has been published,[12] but a brief summary is appropriate here. Each local reporter was asked to return data for a 2-week period in September 2008 on the number of anaesthetics performed in the hospital other than in the ICU and emergency department. For each general anaesthetic, detailed information on the primary airway management technique, defined as that 'used for maintenance of anaesthesia' (facemask, supraglottic airway device, or tracheal tube), was requested. Tracheal intubation included all forms of intubation of the trachea, that is, single- and double-lumen tubes, tracheostomy, surgical bronchoscopy, transglottic, and trans-tracheal techniques. The decision on how to collect these data was left at the discretion of the local reporter. Local data were summed to give cumulative totals and submitted to the project team. After collating all returns, the project team used the submitted data to estimate national annual activity and primary airway techniques used.

Part 2: event reporting (numerator data)

Inclusion criteria

Triggers for inclusion and notification to the project were *complications of airway management* that led to: death, brain damage, the need for an emergency surgical airway, unanticipated ICU admission, or prolongation of ICU stay.

Reports of events occurring in the ICU, in the emergency department, or during transfer were also requested, but these were not used for the calculation of incidence of complications associated with anaesthesia and are the subject of a separate publication.[10] The project did not collect data on events occurring out of hospital or on hospital wards.

Definitions

Brain damage was available as an inclusion criterion. Although this was not defined in detail, the manifestations of central nervous system injury and deficit at 1 month were requested.

Emergency surgical airway was taken to include all forms of emergency access to the upper trachea as part of airway management (i.e. surgical tracheostomy, surgical cricothyroidotomy, needle or cannula cricothyroidotomy, or tracheotomy). Emergency surgical airway was an inclusion criterion only when it did not form part of the primary airway management plan. Thus, if a patient presented with critical airway obstruction and required a surgical airway which was planned and performed successfully either after tracheal intubation or without attempting intubation, the case did not meet inclusion criteria. Where the primary airway management plan failed and a needle/cannula or a surgical airway was performed, this was deemed to meet inclusion criteria.

ICU admission that was required as a result of an airway problem was an indication for inclusion. For patients on the ICU, an airway event which would have led to admission to