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SPECIAL ARTICLE

Failed tracheal intubation during obstetric general anaesthesia: a literature review

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ABSTRACT

We reviewed the literature on obstetric failed tracheal intubation from 1970 onwards. The incidence remained unchanged over the period at 2.6 (95% CI 2.0 to 3.2) per 1000 anaesthetics (1 in 390) for obstetric general anaesthesia and 2.3 (95% CI 1.7 to 2.9) per 1000 general anaesthetics (1 in 443) for caesarean section. Maternal mortality from failed intubation was 2.3 (95% CI 0.3 to 8.2) per 100000 general anaesthetics for caesarean section (one death per 90 failed intubations). Maternal deaths occurred from aspiration or hypoxaemia secondary to airway obstruction or oesophageal intubation. There were 3.4 (95% CI 0.7 to 9.9) front-of-neck airway access procedures (surgical airway) per 100000 general anaesthetics for caesarean section (one procedure per 60 failed intubations), usually carried out as a late rescue attempt with poor maternal outcomes. Before the late 1990s, most cases were awakened after failed intubation; since the late 1990s, general anaesthesia has been continued in the majority of cases. When general anaesthesia was continued, a laryngeal mask was usually used but with a trend towards use of a second-generation supraglottic airway device. A prospective study of obstetric general anaesthesia found that transient maternal hypoxaemia occurred in over two-thirds of cases of failed intubation, usually without sequelae. Pulmonary aspiration occurred in 8% but the rate of maternal intensive care unit admission after failed intubation was the same as that after uneventful general anaesthesia. Poor neonatal outcomes were often associated with preoperative fetal compromise, although failed intubation and lowest maternal oxygen saturation were independent predictors of neonatal intensive care unit admission.

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Keywords: Obstetric anaesthesia; General anaesthesia; Failed intubation

Introduction

The first failed tracheal intubation guideline was developed by Michael Tunstall at Aberdeen Maternity Hospital in the 1970s.¹ Versions of this original guideline for obstetric anaesthesia spread through local adaptation, and simplified guidelines were also applied to non-obstetric cases. The American Society of Anesthesiologists produced an official national guideline on management of the difficult airway in 1992 (last updated in 2013)² and the Difficult Airway Society (DAS) produced an equivalent for the UK in 2004.³ These and other non-obstetric guidelines do not address

the problem that surgery (especially for caesarean section) is often performed to ensure the wellbeing of a different individual to the patient, furthermore, an individual who has no individual legal status before birth. On the other hand, developments in obstetric anaesthetic practice that have had an impact on modifications of Tunstall's guideline include the laryngeal mask and other supraglottic airway devices (SAD), antacid and oral intake protocols during labour, infrequent use of orogastric tubes for stomach emptying, rapid onset non-depolarising neuromuscular blocking drugs and rapid neuromuscular reversal agents. The patient population has changed with a growing prevalence of obesity. Finally, as the use of neuraxial anaesthesia for caesarean section has increased, up to one third of obstetric general anaesthetics are now administered after failed neuraxial anaesthesia.^{4,5}

Accepted June 2015

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The Obstetric Anaesthetists' Association (OAA) and DAS are producing stand-alone obstetric failed intubation guidelines to address the deficit in the DAS 2004 guidelines with respect to obstetric practice. The aim of this review was to search the relevant literature for evidence to support these guidelines, especially with regard to numerical information, management options and maternal and neonatal outcomes.

Methods

We performed an electronic literature search on Medline, Embase, PubMed and National Guidelines Clearinghouse from 1970 to the present. The search terms were: intubation, difficult airway, obstetric, airway problem, cricothyroidotomy, laryngeal mask airway, Proseal, Supreme, video laryngoscope, airway assessment, Mallampati, thyromental distance, physiology of airway in pregnancy, failed intubation, cricoid pressure, rapid-sequence induction, pregnant woman, general anaesthesia. We considered all sources including abstracts and correspondence, with no language restrictions. The resulting list was searched manually for relevant articles. Where appropriate, authors were contacted directly for details of management.

The incidence of failed intubation was calculated when the number of cases as well as the denominator of all obstetric general anaesthetics during a defined time period were reported. When the information was available, the proportion of cases where anaesthesia was continued after failed intubation, as opposed to the patient being awakened, was calculated. This process was repeated for publications where there was information available on case urgency.

For the purposes of analysis the middle year of the range was taken as representative of the data collection period pertaining to each report. Data were analysed using random effects meta-analysis with the Cochran Q statistic for heterogeneity and Clopper-Pearson exact 95% confidence intervals (CI). Forest plots are used to show the data and effect sizes are presented as proportion, odds ratio (OR) and incidence with 95% CI. Trends in proportions and OR over time were analysed using the chi-square trend test, trend in \log_e (OR) and non-linear curve fitting. The software used included Prism 6.0 (GraphPad Software Inc., La Jolla, CA, USA), StatsDirect 2.8.0 (StatsDirect Ltd., Altrincham, UK) and Number Cruncher Statistical Systems 9.0 (NCSS Inc., Kaysville, UT, USA). A P value <0.05 (two-sided) was used to define statistical significance.

We identified reports of the management of single or multiple cases. Cases were also identified from publications that collect and analyse adverse outcomes in maternity care. These included prospective national or regional registry-based outcome collection, an example being the UK Confidential Enquiries into Maternal

Deaths (CEMD). Other sources used included closed claims analyses from the USA and UK, anaesthetic critical incident reporting and publications reporting admissions to intensive care units (ICU). Information was abstracted when the paper contained enough detail to allow evaluation of individual cases.

Results

Definition

The definition of failed intubation is not standard. The lowest threshold for qualification is “*intubation that was not accomplished with a single dose of succinylcholine*”.^{6–8} McKeen et al. defined it as “*unsuccessful attempts at placement of an endotracheal tube into the trachea using either direct laryngoscopy or alternative intubating equipment, the need to proceed with surgery with a non-elective unsecured airway (e.g. bag-mask ventilation or laryngeal mask airway), or the need to abort intubation or surgery and awaken the woman prior to surgery*”.⁹ At the other end of the spectrum is “*inability to intubate during general anaesthesia*”.¹⁰

Incidence of obstetric failed intubation

We found 33 sources providing an incidence for failed intubation at obstetric general anaesthesia, comprising 20 full journal publications, nine abstracts, three databases and one letter (Table 1).^{4,7–9,11–40} Although there was a total of 142 560 women reported or estimated in the reports, it is not possible to exclude overlaps, replicate counting and estimation errors in the sources. As expected there was significant heterogeneity in reported incidences and effect sizes. Because of the use of differing definitions of failed intubation, we re-analysed the number of cases, based on the definition by McKeen et al, in order to provide more comparability between series.⁹ There were 372 cases of failed intubation, giving an overall incidence for all obstetric cases of 2.6 (95% CI 2.0 to 3.2) per 1000 general anaesthetics (1 in 390).

There were 27 sources with data on failed intubation at caesarean section totalling 88 186 cases. The incidence of failed intubation ranged from zero to 1 in 98 in individual sources. There were 181 cases of failed intubation, giving an overall incidence of 2.3 (95% CI 1.7 to 2.9) per 1000 general anaesthetics for caesarean section (1 in 443; Fig. 1). There were two deaths reported in this number,^{13,15} giving an incidence of 2.3 (95% CI 0.3 to 8.2) per 100 000 general anaesthetics for caesarean section (one death per 90 failed intubations). There were three cases reported from these sources where a front-of-neck airway access procedure (surgical airway) was attempted (see below),^{7,15,29} giving an incidence of 3.4 (95% CI 0.7 to 9.9) per 100 000 general anaesthetics for caesarean section (one procedure per 60 failed intubations).

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