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The difficult airway - evolving strategies for successful salvage

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The incidence of the difficult airway in anaesthetic practice

It is estimated that about twenty-two million patients undergo anaesthesia each year in North America. If we accept that the incidence of the 'cannot intubate, cannot ventilate' scenario (CICV) is approximately the estimated 0.01-0.07%, there may be between 2,200 and 15,400 CICV events which must be managed across the continent annually. Similarly, using often quoted incidences for difficult intubation (0.5-2%) there may be 110,000 to 440,000 difficult intubation events, and for failed intubation (0.045-0.3%) there may be 9,900 to 66,000 events annually. Although the incidence of each of these individual events is relatively low, and the expected occurrence of each event infrequent in an individual practitioner's experience, the aggregate number of events in a health care system will be large and the potential for morbidity significant. Efforts to reduce both the occurrence and consequences of these events are obviously warranted. However, even with careful pre-operative evaluation, the occurrence of difficulties with airway management will not be predicted in many instances; strategies to manage these unanticipated difficulties need to be formulated and practiced to allow for successful salvage and minimise the potential for harm. Such strategies were outlined by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway in 1993 and 2003, by the Canadian Airway Focus Group in 1998 and by national groups or societies in the UK, France, Germany and Italy. Consistently, these publications have advocated a practiced strategy for the management of the difficult airway; all also noted the value of alternatives to the direct laryngoscope (DL) when salvaging difficult airway scenarios.

The rationale for pre-formulated salvage strategies for uncommon events

There are fundamentally sound reasons for constructing and practicing a salvage strategy for uncommon events. Most experienced practitioners respond to common mal-occurrences (for example, hypotension on induction of anaesthesia) with rule-based solutions that have been accumulated over time and with experience. However, rule-based solutions do not typically exist for less common or rare events as little or no individual experience has accumulated with these occurrences. Knowledge-based solutions are then necessary; these involve recognition and diagnosis of a mal-occurrence and then generating and applying a solution. Unfortunately, in a unique, complex, fast-evolving, high-threat situation (such as 'cannot intubate, cannot ventilate'), there may be little time to respond with a novel solution before threat turns to injury. The issues relating to the difficulty of thinking clearly in an emergency are also a relevant consideration in these events. Suffice it to say that when stress is high, errors are common and the outcomes seen are frequently less than optimal.

Assessment of current airway management practices

Tracheal intubation is still predominantly achieved with the use of direct laryngoscopy; difficulties related to intubation largely, but not exclusively, involve difficult direct laryngoscopy. A number of innovative new tools for tracheal intubation have been presented in recent years which address many of the factors which give rise to difficulties during direct laryngoscopy. Despite the apparent value of these techniques, anaesthesia teachers seem to have been reluctant to teach them and practitioners slow to adopt them. Difficult laryngoscopy is most often managed with persistent attempts at direct laryngoscopy and the use of alternative approaches to tracheal intubation is uncommon. In patients managed in this fashion, there is a higher incidence of desaturation at induction, oesophageal intubation, dental damage and unexpected ICU admissions. Such patterns of practice (more than two attempts) applied to critically ill patients increase the risk of hypoxaemia, oesophageal intubation, regurgitation, aspiration, bradycardia and cardiac arrest.

It is likely that such over-reliance on direct laryngoscopy is a risk-enhancing behaviour which predisposes patients to morbidity and mortality. Yet, there is evidence that such behaviour is common among anaesthesiologists. Rosenblatt surveyed a random sample of the active membership of the American Society of Anesthesiologists [1]. Experienced practitioners tended to use higher risk induction techniques and used the direct laryngoscope almost exclusively; their use of alternative devices and adjuncts was uncommon, occurring in <5% in all scenarios. Jenkins surveyed 833 Canadian anaesthesiologists and reported that the direct laryngoscope was the preferred technology overall; more experienced, male gender and older practitioners were again more likely to choose asleep induction for high-risk scenarios [2]. Kristensen similarly assessed airway management behaviour, experience and knowledge among Danish anaesthesiologists and observed that both high-risk attitudes and behaviours were common [3]. Again, there was little experience with or enthusiasm for using alternatives to the direct laryngoscope. Ezri's more recent survey of American anaesthesiologists suggests that there may be an increasing willingness to use alternatives to the direct laryngoscope [4]. However, Ezri also reported that that willingness persisted even when the anaesthesiologists acknowledged that they weren't comfortable nor experienced with the alternate technology that they proposed using in these difficult situations.

The use of alternative devices in anaesthetic airway management

Two questions arise as we acknowledge the slow uptake of alternate airway technology by anaesthetists: do we actually possess the necessary skills to apply alternate airway technology and are we teaching those skills to the next generation? The following discussion will focus on the fiberoptic bronchoscope / endoscope (FOB) but it is likely the same issues apply to most alternate technologies. Wong et al surveyed Canadian anaesthesiologists and reported that 8% of consultants had never done an awake fiberoptic intubation (FOI) in their career; this number rose to 20% for anaesthesiologists > 55 yr of age [5]. Eighteen percent had never done an asleep FOI and again the number was higher (25%) for those > 55 yr. Kristensen and Møller reported similar findings after a survey of members of the Danish Society; 23% of specialists had never done an awake intubation using a FOB and 21% had never done an asleep FOI [3]. Access to the technology was an issue in the Danish survey; 17% reported that they had no access to a FOB and 14% had limited access to a FOB. Dawson et al surveyed anaesthetists and trainees in New Zealand [6]. The median number of FOI performed in their career was 20 for consultants and eight for trainees, and the median number performed each year was three for consultants and four for trainees. Only 14% of survey respondents considered themselves experienced in the use of the FOB despite the fact that 84% of consultants and 99% of registrars felt that FOI was a skill expected of all anaesthetists.

Prevalence of advanced airway training

With respect to training and teaching, Hagberg et al reported that only 33% of American training programs responding to a survey had difficult airway rotations; 61% of the rotations were only one week in length [7]. Mackinnon and Dobson reported that 84% of registrars rated the organisation of their airway training as less than satisfactory and only 36% felt confident in the management of the difficult airway on completion of their training [8] The opportunity to gain 'hands on' experience with the FOB has been rated as less than satisfactory by 49%-59% of anaesthetists surveyed in New Zealand and the UK [6, 8] Goldmann and Braun assessed airway management practices and teaching at 212 hospitals in Germany [9]. Although FOB were available in all units, video-endoscopy was routinely used in only 29% and never used in > 50% of units. FOI was never done by junior trainees in 54% of units and never done by seniors in 8%; 39% of centres offered no organised practical experience in difficult airway management. It is perhaps not surprising then that authors expressed concerns about residents' (registrars) lack of knowledge and practical skills in handling the difficult airway. Rosenstock et al assessed the knowledge and airway management skills of residents attending a compulsory simulator course [10]. Participants had an average of 60 months training (range 38-108) at the time of assessment, yet only 71% felt competent regarding airway management. Despite the fact that 78% had daily access to FOB, only 14% would consider performing an awake FOI if difficulties were anticipated. McNarry surveyed delegates at the Group of Anaesthetists in Training (UK) meeting [11]. Most trainees believed that FOI was a core skill and that all anaesthetists should be competent by the end of their training. Trainees believed that competence was achievable after performance of 10 FOI yet the median number of FOI done was two and most Senior House Office and year 1 or 2 Specialist Registrars (SpR) had never performed a single FOI. Most year 3/4 SpRs had performed FOI an average of three times in their training and most final year registrars (60%) had not undertaken 10 FOI, the minimum number that they felt necessary to be competent.

Expectations and attitudes play a role in practice and teaching. Although emergency airway management is defined as a core area of education in the harmonised guidelines for education and training in the specialty of anaesthesiology throughout the EU, no recommendation is made regarding the specific interventions which should be taught nor the minimum number which should be achieved over the recommended 5 yr of training [12]. Bokhari et al conducted a clinical scenario-based survey regarding management of a difficult airway among anaesthetists in the Oxford area [13]. The first scenario addressed was an unanticipated grade 3-4 laryngoscopy. Interestingly, among the technical options available to choose, all were related to optimising conditions for direct laryngoscopy or employing an adjunct to the DL. The use of an alternative to the DL was not an option provided in the survey, suggesting that even the authors did not anticipate selection of such a choice by respondents. Finally, although respondents to a survey of Dutch anaesthetists acknowledged a median frequency of two failed intubations annually when using the direct laryngoscope, 46% reported that they had no protocol for managing such events [14]. Of particular concern from a training perspective, 21% of respondents acknowledged that they never or only occasionally perform airway assessments and 16% considered an awake intubation to be an unethical choice for airway management.

The efficacy of salvage strategies in difficult airway management

Although studies have demonstrated the individual utility of some new airway devices, there was until recently little published evidence that they have been incorporated widely into clinical practice or that their use had changed the outcomes in difficult airway events. Hung was among the first to observe and report on the outcomes of early conversion to an alternate technique when direct laryngoscopy was difficult [15]. In his report, the use of the lighted stylet resulted in successful tracheal intubation quickly and without important complications. More recently, Heidegger et al reported the results of the application of a protocol for the management of both anticipated and unanticipated difficult intubations which emphasized defaulting to the FOB early when difficult laryngoscopy was anticipated or observed [16]. Applied in 13,248 intubations, the protocol failed in only six patients (0.045%) and again was associated with minimal morbidity. Burkle et al also reported the value of the FOB for salvage of failed direct laryngoscopy noting that in 93% of the cases that it was employed, there was a successful resolution and a low incidence of morbidity [17]. Connelly et al reviewed and analysed 447 reports of difficult and failed intubation in 168,000 general anaesthetics (0.26%) administered at an academic health sciences centre between 1998 and 2005 [18]. Salvage techniques were employed at the discretion of the attending physician; if persistent DL was the technique of choice, success occurred in 22% of cases. Success was much higher when alternate devices were used for salvage being 90% for the FOB, 87% for the LMA and 84% for the Bullard laryngoscope.

Technological innovations applied to teaching and training

Innovation in technology also has the ability to improve the effectiveness of training interventions. Two relatively recent innovations which would seem particularly beneficial to teaching are video-integrated airway devices and simulators. Low et al have demonstrated that training novices laryngoscopy using a video laryngoscope improves performance under subsequent simulated difficult airway conditions with respect to number of attempts, number of repositioning manoeuvres, dental trauma, knowledge of airway anatomy, and confidence of tracheal tube placement [19]. Goldmann and Steinfeldt have reported that use of a virtual reality simulator allows for relatively rapid acquisition of basic FOI skills among trainees [20]. The model used for simulation need not be an expensive one, as Naik et al reported that training novices with a simple model before attempting to perform FOI on anesthetized patients significantly shortened time to successful intubation and increased success of FOI [21]. Applying multiple approaches to teaching technical skills is likely to improve trainee's rate of acquisition of skills and trainer's efficiency in passing on skills. Any exercise that increases trainee's tactile familiarity and facility with technology and trainer's ability to monitor directly the trainee's experience is likely to enhance training.

Ensuring competency in airway management

With respect to how many times an intervention should be carried out in training to ensure competency, the number is probably larger than some seem to presume. The intubation learning curve using a direct laryngoscope reaches a 90% success rate after between 50 and 60 attempts. Cumulative sum (cusum) analysis of learning curves suggests that acceptable failure rates are achieved after a mean of about 40 attempts; there is a large standard deviation suggesting the presence of both quick and slow learners among

trainees. Despite the fact that there is a marked improvement in skill after about 20 attempts, even after 80 intubations a significant proportion of trainees require assistance with subsequent intubations. Similarly, an analysis of FOB skills acquisition reported that an average of 40-50 attempts would be required to provide for basic competency, reducing the risk of failure to <2.5% and ensuring completion in approximately 35 s. It is likely that most novices being trained by experienced anaesthetists will achieve basic skills by about 20 attempts and reliable competency by about 50-70 attempts with both the direct laryngoscope and many alternative devices. Maintenance and further enhancement of skills will require ongoing and regular use of the devices in practice.

Evolving a care paradigm for difficult airway management

Conventional airway practice employing a direct laryngoscope serves the majority of patients presenting for anaesthetic care well. However, there is a population of patients for whom exclusive reliance on direct laryngoscopy is a high risk strategy resulting in morbidity and occasional mortality and the use of alternative devices should be considered. Application of the guidelines and recommendations offered by national groups and societies can result in the creation of local protocols which will prove highly effective in resolving airway crises resulting from difficult direct laryngoscopy. Integral to these protocols will be the application of adjuncts and alternatives to the direct laryngoscope as these devices seem capable of resolving many of these scenarios efficiently and safely. The evidence suggests that experience with a small number of alternatives is sufficient for the practitioner to successfully resolve most difficulties. Thus we should emphasise practitioners developing experience and a high comfort level with a limited number of alternatives rather than limited facility with a large range of alternatives. Opportunities for training with these newer technologies in both academic programs and in continuing education must be fostered. Although efforts are clearly underway at present to resolve some of these barriers to safe airway care, real airway safety will require further expenditure of both energy and resources. It is likely that motivation among anaesthesiologists to improve care will be the factor that determines whether this enterprise is successfully concluded.

Key Learning Points

- Difficulties with airway management continue to be an important cause of anaesthesia-related injury.
- It is not always possible to accurately predict the occurrence of difficulties with airway management.
- There is an advantage to having pre-formulated and practiced solutions to allow for salvage of the difficult airway.
- Alternatives to the direct laryngoscope are useful devices for the salvage of a difficult airway.
- Opportunities for acquiring and maintaining skills with new airway devices need to be improved.

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