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Emergency front-of-neck airway: strategies for addressing its urgency

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The performance of an emergency front-of-neck airway (eFONA) is a time-critical task that is often associated with poor patient outcomes and significant long-term psychological impact on healthcare personnel. In this issue of the *British Journal of Anaesthesia*, Groom and colleagues[1] show that anaesthetists who have trained in eFONA could perform as skilfully as head and neck surgeons when presented with a simulated 'can't intubate, can't oxygenate' (CICO) scenario. Their work supports the need for multidisciplinary CICO training as part of a complex management strategy. eFONA is not a common procedure, and yet, it has high-stakes outcomes for patients.

The study by Groom and colleagues[1] showed that there were no significant differences in deliberation time between anaesthetists, head and neck surgeons, and general surgeons (median times: 30, 31, and 23 s, respectively). However, the procedural time was significantly different amongst the three groups, with anaesthetists taking a median time of 50 s, head and neck surgeons 74 s, and general surgeons 86 s. In contrast, findings from the 4th National Audit Project[2] showed that nine patients had a surgical airway completed in under 5 min, whilst 11 patients took more than 1 h to secure the airway. Are these differences in deliberation and procedural times clinically important?

It should be recognised that, in a crisis, time is critical. Currently, no evidence exists to recommend a minimum duration from start of CICO to completion of eFONA. Groom and colleagues[1] divided the time for eFONA into (i) deliberation time (from onset of CICO to starting eFONA) and (ii) procedural time (from starting to finishing eFONA). The former would normally include any time delay by the anaesthetist to declare that eFONA is required and the time to bring eFONA equipment to the point of care.

Using their terminology, we can postulate what the reasonable times are for both deliberation and procedural eFONA. Obviously, ethical constraints do not allow prospective research in this area. However, modelling studies to predict the time for significant oxyhaemoglobin desaturation and possible hypoxic brain damage with loss of airway provide a surrogate for calculation of an appropriate target time for eFONA management.[3,4]

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One such model[5] describes the time course of oxyhaemoglobin desaturation during apnoea for various conditions, such as obesity, increased age, and postoperative status. The time to significant life-threatening haemoglobin desaturation (SaO_2 ≤80%) with initial FAO_2=0.87 during complete obstructive apnoea in the CICO situation can be up to 8 min in healthy adult patients to just more than 3 min in obese patients.[6]

The deliberation times in the study of Groom and colleagues[1] are well within these figures. However, these times are based on a rapid declaration of the CICO scenario and that an eFONA was required. The eFONA equipment may be either at the point of care or in a nearby difficult airway management trolley. If it is the latter, then additional time is required to locate and deliver the trolley to the point of care. As various technical and non-technical factors can delay the deliberation time, we believe that deliberation time should be considered as a time frame for planning for eFONA. This planning should consider whether the eFONA equipment is stored at the point of care or in a difficult airway trolley that is no more than 8 min from the point of care.

The time for performing eFONA and avoidance of hypoxic encephalopathy is directly dependent on the oxygen content in the brain. However, the partial pressure and oxygen concentration in the brain are low and non-uniform. Under physiological conditions, increased oxygen demands are met by increased cerebral blood flow. Consequently, hypoxia and ischaemia have different effects on the brain. Ischaemia leads to elevated extracellular glutamate concentrations, which can cause neuronal damage. Short-term severe hypoxia without ischaemia does not cause elevated extracellular glutamate concentrations[7] or pathological changes.[8] When hypoxia occurs but cerebral blood flow is maintained, irreversible neuronal damage may occur in 4–15 min depending on the degree and abruptness of the insult. However, if both hypoxia and ischaemia occur, irreversible neuronal damage may occur in 1–4 min[9] with escalating patient morbidity and mortality.[10] Therefore, we postulate that the procedural time for eFONA should be performed within 3–4 min,[11] and this time frame needs to be part of eFONA training programmes.

In reality, the available time for eFONA management begins with recognition that the control of the airway has been lost, accessing the appropriate equipment and successful reoxygenation of the patient. We propose that training curricula should consider time-management strategies that address these various components of the overall time from the onset of CICO to completion of an eFONA. In 2016, UK anaesthetists and head and neck surgeons adopted surgical cricothyroidotomy as the optimal FONA technique for a CICO emergency.[12] Despite these recommendations, there remains a shortfall in training and knowledge amongst surgeons.[13] The qualitative results of Groom and colleagues[1] emphasise this ongoing problem. Many participants in this study had little real-life experience of either CICO or performing an eFONA. Some of the participants had previous experience with high-fidelity simulated emergency training, but the lower incidence of the vertical incision for a non-palpable cricothyroid membrane scenario amongst the surgical participants is an issue to be addressed. These results may be partly attributable to lack of training, differences in eFONA techniques taught at training courses, and the time elapsed since the eFONA training (In the study of Groom and colleagues,[1] all anaesthetic consultants had training in the previous 6 months; the median time for head and neck surgeons was 2.5 yr and for general surgeons was 14 yr.). Further work is required to disseminate the Difficult Airway Society guidelines[14] outside the anaesthetic community, and integrate them into regular multidisciplinary training courses.

As eFONA is a time-critical task, management of various CICO scenarios should be underpinned by universal operative team training. The narrow time frame for eFONA requires multidisciplinary training, in which the entire team actively engages in shared 'deliberate practice'.[15] This entails training that focuses on improving eFONA success, immediate feedback, time for problem-solving, evaluation, strong interpersonal support, and opportunities for repeating performances to improve the success rate.[16] These same principles permeate many world-class sporting teams and military operations that require fast-tempo high-stakes teamwork for managing unplanned contingencies. As Groom and colleagues[1] correctly point out, the success of eFONA depends on both procedure simplicity and regular rehearsal.

The study by Groom and colleagues[1] focused on three specialties: anaesthetists, head and neck surgeons, and general surgeons. Several surgical sub-specialties routinely operate in the neck region, including ear, nose, and throat; plastic and reconstructive; maxillofacial; orthopaedic and neurosurgical (e.g. anterior cervical fusion); vascular (e.g. carotid surgery); and endocrine (e.g. thyroid and parathyroid surgery). In addition, non-surgical specialties may also be required to perform eFONA, including anaesthetists, physicians in intensive care, emergency, and retrieval medicine.[17]

Groom and colleagues[1] used a manikin that produced prosthetic bleeding to mimic a patient with an impalpable cricothyroid membrane. Future eFONA training curricula should explore the integration of both anaesthetic and surgical expertise by exploring various CICO scenarios within training programmes. These scenarios should include the different causes of postoperative neck haematomas with an associated impalpable cricothyroid membrane. The cause of eFONA is likely to differ in different circumstances: in anaesthetic settings, it is most likely to be as a result of iatrogenic airway oedema; in the emergency medicine department, it is commonly attributable to oedema or trauma; and after head and neck surgery, a variety of different haematomas can arise, each with a different pathology.

How these haematomas cause airway compromise can be governed by their position within anatomical planes, which in turn is related to the type of surgical operation. For example, post-thyroidectomy bleeding deep to the strap muscles is more likely to be associated with airway compromise than a superficial haematoma.[18] Mandibular surgery causing lingual, sublingual, submandibular, and submental haematomas may cause airway obstruction by displacing the tongue superiorly or posteriorly.[19] A wound haematoma after anterior cervical spine surgery may cause airway compromise because of swelling of the posterior pharyngeal wall or the paratracheal compartment of the neck.[20] Therefore, the eFONA rescue technique should consider the cause of the oedema or haematoma, and if the cause is a haematoma, its site and effects.

In some situations, the anatomy of the neck can be altered with deviation of the trachea from the midline. A few basic surgical tenets should be considered when performing eFONA. If the hematoma is above the level of the hyoid, then the trachea will probably still be midline and a standard surgical eFONA technique can be used. If the haematoma is below the hyoid, such as post-thyroidectomy or anterior cervical spine haematomas, then it may cause tracheal deviation. Rapid

release of a haematoma can allow a reduction in airway pressure and improve the identification of the trachea for direct access. These tenets are based on fundamental surgical principles and allow a more time-focused management of neck haematomas as causes of CICO scenarios. A similar analysis of cause and effect may be possible for other CICO causes. However, future research is required to assess their validity in both eFONA training programmes and real-life scenarios.

If an anaesthetist fails to secure an airway, then this should be declared early and clearly so that the shift to eFONA can commence. Communication and mutual understanding of individual roles are vital in such situations. The 'scalpel–bougie *vs* cannula' debate continues,[12,21] and a wide range of proprietary devices and kits are available. However, the success or failure appears to rely more on operator experience and skill rather than on technique.[22,23] It is critical to allow the best practitioner to use the most appropriate method of eFONA with which they are trained and with full support from the rest of the operative team.

One of the authors (KBG) assessed the emergency surgical airway management in 2011.[24] eFONA remains an airway management strategy that is infrequently used, but is often associated with poor outcomes. Proposals on how to improve eFONA management are shown in Table 1. Groom and colleagues[1] emphasise the importance of regular, problem-focused, multidisciplinary eFONA training. Any improvement in how eFONA is performed is likely to require major changes in airway management training, particularly in the handling of human-factor analysis. The aviation industry is often used as a standard for the analysis of human factors in airway management.[25] A better analogy for a time-critical multidisciplinary task may be a performance analysis of Formula 1 racing pit stop crews for understanding the precision, efficiency, and focused teamwork required.[26] This model may prove useful when extended to eFONA training.

Table 1 Proposed future changes to improve emergency front-of-neck airway (eFONA) management outcomes.

Action	Comments
Reporting	Mandatory reporting of all eFONA to a national difficult airway management body Centralising and analysing eFONA data
Standardisation of eFONA equipment at point of care	All critical areas where airway management occurs, including anaesthesia, intensive care, emergency medicine, rural and remote medicine, and off-site areas where sedation is occurring
Research into different causes of can't intubate, can't oxygenate	Impact of various causes of cervical haematomas, infection, and trauma on the airway with associated 'best practice' for management
Mandatory time-critical multidisciplinary training, including periodic airway management workshops, in which emergency surgical airway skills should be mandatory	Trainees: commence training early in anaesthetic training Consultants: continue training as a regular mandatory part of professional development
Organisational changes	Clear communication and cooperation between specialties should be encouraged (especially anaesthesia, otolaryngology, intensive care, and emergency medicine) to promote timely management of emergency surgical airways Emphasis on inter-specialty training

Authors' contributions

Both authors made substantial contributions to drafting the editorial, overview of key concepts, and final approval of the submitted manuscript.

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Declaration of interest

The authors declare that they have no conflicts of interest.

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Perioperative ST-elevation myocardial infarction: with time of the essence, is there a case for guidelines?

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With the announcement by the Royal College of Anaesthetists of the National Audit Programme 7 (NAP7) on perioperative cardiac arrest, it is opportune to examine the management of early perioperative ST-elevation myocardial infarction (STEMI), a life-threatening, adverse event. With pharmacological and technical developments in coronary reperfusion over recent decades, together with substantial evidence on the impact of early reperfusion on survival, primary percutaneous coronary intervention (pPCI) has evolved as first-line treatment for STEMI. There are UK guidelines for the management of STEMI [National Institute for Health and Care Excellence (NICE); updated November 2018][1] and also guidelines on myocardial revascularisation from the European Society of Cardiology and European Association Cardiothoracic Surgery 2018.[2] Yet there is no consensus on the management of STEMI in the perioperative setting.

Perioperative STEMI

Perioperative myocardial infarction (PMI) is an uncommon and life-threatening event. The incidence of PMI depends on