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Need to consider human factors when determining first-line technique for emergency front-of-neck access

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Emergency cricothyroidotomy is a temporary, life-saving procedure, indicated immediately when the airway is obstructed and oxygen delivery is unable to be restored by other means. It is therefore the final step in the guidelines for the management of difficult airways, reserved for can't intubate, can't oxygenate (CICO) emergencies. Debate over whether use of a cannula or scalpel provides the best technique for emergency front-of-neck access by anaesthetists in these circumstances must logically consider the likelihood of technical success of each of these methods. The effectiveness of either technique as a rescue strategy is also dependent, however, on a clinician's willingness to implement it.

The recently published 2015 Guidelines of the Difficult Airway Society (DAS) endorse scalpel cricothyroidotomy as the sole method for emergency front-of-neck access.[1] This editorial addresses the possible implications of this decision on the psychological preparedness of clinicians to undertake the transition to emergency surgical airway. The updated DAS Guidelines acknowledge that much of the data for this recommendation comes from sources which cannot be translated directly to in-hospital anaesthetic practice.[1] The lack of clear technical superiority of one technique over the other, combined with the knowledge that the decision to perform front-of-neck access is frequently undertaken too late or not at all,[2–4] further increases the weight that must be given to the impact that these techniques might have on a clinician's 'willingness to act' in the CICO scenario.

Appropriate decision-making, availability of equipment, technical ability, and human factors considerations, all supported by regular training, are essential for successful performance of front-of-neck access techniques when a CICO event occurs. As such, the following considerations potentially make a cannula-based technique more suitable than the scalpel-based technique for the anaesthetist in their initial attempt at front-of-neck access.

(i) Familiarity: as noted in the DAS guidelines,[1] cannula-based techniques are already familiar to anaesthetists, which may lead to them being implemented sooner.[5]

(ii) Training: obtaining tracheal access with a cannula is a relatively low-risk procedure,[6] which affords opportunities for regular practice on live human subjects in an elective setting (e.g. when performing a transtracheal block for awake intubation). Other than using a smaller-gauge cannula, the procedure may be performed in an identical manner to that used for emergency airway access and is fairly well tolerated by patients.[7] The ability to practise this technique on patients would be expected to improve clinicians' technical abilities. Importantly, it would also help to diminish the significant psychological barriers to undertaking front-of-neck access by reinforcing the minimally invasive nature of the procedure and improving familiarity and confidence. These opportunities are not available with the more traumatic scalpel techniques, in which complications are predominantly related to insertion rather than oxygen delivery.[8] As such, scalpel techniques can be practised only using synthetic models, cadavers, or live animals. Given the limited access of most clinicians to live animal specimens, this largely restricts practice of scalpel technique to the bloodless field of synthetic or cadaveric airways, resulting in a significant loss of fidelity. This is likely to be pertinent to the ability to transfer these skills to clinical practice in an emergency airway situation.

(iii) Pre-emptive use: the low-risk nature of cannula access[6 8] provides the additional benefit that placement of a cricothyroid cannula is able to be instituted as a precaution, before a CICO situation develops. Such pre-emptive use may be undertaken in periods of confirmed alveolar oxygen delivery during the process of managing the difficult airway and has even been advocated as an option before induction of anaesthesia in patients with a suspected difficult airway.[2]

Pre-emptive cannula placement allows the procedure to be performed in a more controlled manner, at a point where motor skills are better preserved, thereby theoretically increasing the likelihood of success. Additionally it affords another legitimate opportunity for clinicians to enhance familiarity with the technique in live human patients. It also ensures that if a CICO situation manifests itself, the significant psychological barriers to performing invasive airway access have already been overcome. The cannula can also serve as the first step of the needle-guidewire technique to insert a small-bore tracheal tube. Conversely, if a CICO scenario is averted, the tracheal cannula can be removed with minimal risk of morbidity or can be left in place for use in a difficult extubation strategy. In contrast, the scalpel technique is more likely to be reserved for the occurrence of genuine CICO events because of its inherent risk of tissue trauma and bleeding. These risks make it more psychologically challenging and, thus at greater risk of delayed performance. Even if cannula access to the trachea is not undertaken until the point at which a CICO situation arises, the same factors mentioned above would increase the likelihood that clinicians establish cannula access early. Waiting for the onset of desaturationed should not necessarily be part of the trigger for front-of-neck access.[9] In this circumstance, having restored airway patency and the ability to achieve alveolar oxygen delivery via the cannula, there is no need to undertake the process of oxygen insufflation (the component of this technique predominantly associated with risk of complications),[8] unless blood oxygenation begins to deteriorate.

A key consideration in the timely transition to front-of-neck access in an airway crisis is minimizing the psychological barriers to clinicians performing this invasive procedure. Anaesthetists have demonstrated a preference for using cannula over scalpel technique for front-of-neck access.[1 2 10] There is questionable value in advocating a technique that, although theoretically more likely to be successful, may also be at greater risk of being implemented too late or not at all in a 'real-world' context.

The evidence to promote a single technique for front-of-neck access is weak. The incidence of CICO events is rare in the in-hospital setting, and when they occur in the operating room or intensive care unit, these events are usually managed by the anaesthesia team. In contrast, most CICO data are obtained from scenario-based training using manikin, cadaver, or wet lab facilities or from case series, typically in out-of-hospital or emergency department settings.[1] When interpreting the low success rates of cannula techniques in the NAP4 data, it is worth noting that most of the scalpel surgical airways in this series appear to have been performed by surgeons, trained in the procedure. Several of these were undertaken over a time frame in excess of 1 h, presumably in circumstances where a degree of ongoing oxygenation from above was still possible. In contrast, the cannula techniques appear to have been performed in the time-critical circumstance of genuine CICO situations, by anaesthetists, who have typically been largely untrained to perform this procedure.[2 3] Given these confounding factors, it is not surprising that the cannula techniques were associated with worse outcomes, and it has been acknowledged that, consequently, the NAP4 data do not necessarily support the conclusion that cannula techniques are less safe.[3] There is some evidence that in the context of a dedicated training programme, anaesthetists have high success rates with cannula techniques.[11]

It makes sense to remove the ambiguity of making a choice between cannula and scalpel techniques at the moment when a CICO situation occurs. In the absence of clear evidence supporting one method over another, however, it should be up to institutions or individuals to determine in advance which technique should be used initially, based on their preferences. The argument that the equipment to perform scalpel techniques for front-of-neck access is more readily available can be addressed by including the equipment for cannula techniques and oxygen insufflation in the list of required equipment on a difficult airway trolley, as is the case in the USA, Germany, or Australia.[12–14]

Likewise, concerns about availability and familiarity with high-pressure oxygen delivery devices may be addressed by equipment, such as the Enk Oxygen Flow Modulator (Cook Medical, Bloomington, IN, USA),[15] the Rapid-O2 (Meditech Systems Ltd, Shaftesbury, UK),[5] or the Ventrain (Dolphys Medical BV, Eindhoven, The Netherlands).[16 17] These provide, in contrast to a jet ventilator, an affordable, simple mechanism for oxygen insufflation via a cannula that can be connected to a standard oxygen outlet and allows for passive or even active expiration via the cannula between breaths. Techniques have been developed for use of these devices, intended to minimize the risk of complications from volutrauma and barotrauma, even when the upper airway is completely obstructed.[5 18] The need for such stipulations about equipment and training requirements is not unique to the performance of a cannula technique and will equally need to be applied to the scalpel technique to ensure the immediate availability of the broad number 10 blade scalpel (stated to be 'essential' in the DAS guidelines) and familiarity with the specific minimally invasive techniques advocated for its safe performance.[1]

Given the importance of early front-of-neck access in the CICO scenario, cannula techniques potentially offer advantages from a human factors perspective when supported by appropriate education programmes. Although better training in the scalpel technique may improve the willingness of anaesthetists to perform it, using a scalpel is still likely to remain a rare and intimidating intervention for most anaesthetists. Moreover, directing similar resources towards training in the cannula technique, combined with the potential increase in opportunities for practice on live human subjects, is likely to improve the technical success rates of this procedure.[11] Much of the evidence regarding the technical and human factors superiority of one technique over another remains largely speculative, thus it seems difficult to justify the exclusive recommendation of any one technique.

In summary, the sole recommendation of a scalpel technique may increase the psychological barriers to successful achievement of front-of-neck access in an appropriate time frame when a CICO situation occurs. Training in both techniques remains warranted, and the option to use either technique should continue to be advocated.

Declaration of interest

None declared.

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In support of 'usual' perioperative care

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Compelling evidence from three recent large randomized controlled clinical trials (RCTs) [Protocolised Care for Early Septic Shock (ProCESS),[1] Australasian Resuscitation in Sepsis Evaluation (ARISE),[2] and Protocolised Management in Sepsis (ProMISe)[3]] led the Surviving Sepsis Campaign to update its guidelines for the initial management of patients with confirmed or suspected severe sepsis.[4] Guidelines now recognize 'usual' non-protocolized care delivered by licensed independent practitioners as equivalent to the algorithmic early goal-directed therapy (EGDT) protocol during severe sepsis.[4] Clinicians caring for patients around the time of major surgery may find a review of EGDT, including its initial success, current equipoise *vs* usual care, and potential physiological explanations for this equipoise, informative when considering whether goal-directed fluid therapy (GDFT) algorithms represent a similar paradigm with regard to perioperative haemodynamic optimization. We provide a framework in which to consider whether GDFT should be implemented routinely in perioperative settings *vs* usual non-protocolized care administered at the discretion of treating clinicians.

Early goal-directed therapy for severe sepsis

Initial success

Early goal-directed therapy gained prominence after an influential, albeit small, RCT conducted by Rivers and colleagues[5] from 1997 to 2000 at a single urban, tertiary care hospital in the USA between 1997 and 2000 that enrolled patients with suspected or confirmed severe sepsis. In this study, all subjects received arterial and central venous catheterization, critical care consultation, and emergency admission for inpatient care, with relevant specimens obtained for culture before the administration of antibiotics in the emergency department. Subjects were randomized to either a protocolized approach to resuscitation (EGDT) or to