Declaration of interest

Production of the educational videos was performed free of charge by Hyperexis, a company owned by one of the authors (CIM). The other authors declare that they have no conflicts of interest.

References

1. Frerk C, Mitchell VS, McNarry AF, et al. Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults. *Br J Anaesth* 2015; **115**: 827–48
2. Hubble MW, Wilfong DA, Brown LH, Hertelendy A, Benner RW. A meta-analysis of prehospital airway control techniques part II: alternative airway devices and cricothyrotomy success rates. *Prehosp Emerg Care* 2010; **14**: 515–30
3. Heymans F, Feigl G, Graber S, Courvoisier DS, Weber KM, Dulguerov P. Emergency cricothyrotomy performed by surgical airway–naive medical personnel. A randomized crossover study in cadavers comparing three commonly used techniques. *Anesthesiology* 2016; **80**: 204–9
4. Schober P, Hagemann MC, Schwarte LA, Loer SA, Noetges P. Emergency cricothyrotomy – a comparative study of different techniques in human cadavers. *Resuscitation* 2009; **80**: 204–9
5. Chrisman L, King W, Wimble K, Cartwright S, Mohammed KB, Patel B. Surgicric 2: a comparative bench study with two established emergency cricothyroidotomy techniques in a porcine model. *Br J Anaesth* 2016; **117**: 236–42
6. Cook TM, Woodall N, Frerk C, Fourth National Audit Project. 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. *Br J Anaesth* 2011; **106**: 617–31
7. Wong DT, Mehta A, Tam AD, Yau B, Wong J. A survey of Canadian anesthesiologists' preferences in difficult intubation and "cannot intubate, cannot ventilate'' situations. *Can J Anesth* 2014; **61**: 717–26
8. Fiorellia A, Carellia E, Angiolettia D, et al. A home-made animal model in comparison with a standard manikin for teaching percutaneous dilatational tracheostomy. *Interact Cardiovasc Thorac Surg* 2015; **20**: 248–53
9. Wang EE, Vozenilek JA, Flaherty J, Kharasch M, Aitchison P, Berg A. An innovative and inexpensive model for teaching cricothyrotomy. *Simul Healthc* 2007; **2**: 25–9
10. Groom P, Schofield L, Hettiarachchi N, et al. Performance of emergency surgical front of neck airway access by head and neck surgeons, general surgeons, or anaesthetists: an in situ simulation study. *Br J Anaesth* 2019; **123**: 696–703
11. Bandura A. Self-efficacy mechanism in human agency. *Am Psychol* 1982; **37**: 122–47
12. Booth AWG, Vidhani K. Human factors can't intubate can't oxygenate (CICO) bundle is more important than needle versus scalpel debate. *Br J Anaesth* 2017; **118**: 466–8
13. Moneypenny MJ. When are 'human factors' not 'human factors' in can't intubate can't oxygenate scenarios? When they are 'human' factors. *Br J Anaesth* 2017; **118**: 469

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Improving laryngoscopy technique and success with the C-MAC® D blade: development and dissemination of the 'Bath C-MAC D blade guide'

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Keywords: airway; education; laryngoscopy; tea trolley teaching; training; tracheal intubation; videolaryngoscopy

Editor—We are aware that some hold the opinion that videolaryngoscopy improves the view at laryngoscopy, but that tracheal intubation is difficult despite this.[1] This situation is more commonly described with hyperangulated videolaryngoscope blades such as the C-MAC® D blade (Karl Storz GmbH, Tuttlingen, Germany). Such hyperangulated blades have the advantage that they can 'see around the corner,' but because of this, direct visualisation of the vocal cords is prevented.[1]

In our hospital we have been using videolaryngoscopy for all intubations ('universal videolaryngoscopy') in operating theatres, delivery suite, and the ICU for the past 18 months.[2] We emphasise that when an intubator is able to see the vocal cords when using a hyperangulated videolaryngoscope blade but is unable to intubate, this is likely because of poor technique or training in the vast majority of cases.

The C-MAC® D blade can be inserted into the patient's mouth either in the midline or conventionally along the right side of the tongue, watching the tip of the blade as it is inserted into the mouth and, when it disappears from view, continuing to watch the tip on the videolaryngoscope screen. We propose that the key element is to optimise the view of the larynx, it works well to mentally divide the ovidelaryngoscopy screen

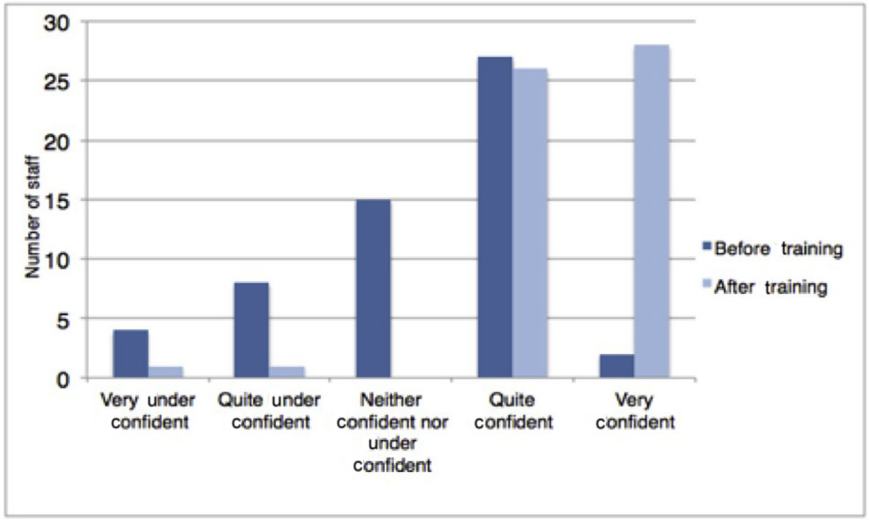

Fig 1. Self-reported confidence in the use of the C-MAC® D blade before and after tea trolley training.

into a 3x3 grid of 9 rectangles and to aim to localise the vocal cords in the middle rectangle. In our experinece The tracheal tube should be formed into a shape that closely resembles the curve of the C-MAC® D blade, with a preformed stylet, a curved malleable stylet, or a stylet than can be 'activated' into a curved shape. It is wise to use a tracheal tube half a size smaller than usual, and a reinforced straight tracheal tube may be suitable. Both the stylet and the tracheal tube tip should be lubricated. The tip of the tracheal tube should then be slid along the surface of the C-MAC® D blade and it will automatically and reliably pass to where the camera is directed (i.e. into the glottis). This also avoids any risk of trauma to the pharyngeal wall as a result of any perceived 'blind spot.' A bougie is not recommended as it unfurls during intubation rapidly, either leading to a rushed intubation or risking a failed intubation when the curvature is inadequate. Once the styletted tube reaches the glottis, the stylet should be withdrawn as the tube is advanced. If there is any resistance, the tracheal tube can be rotated 30–45° clockwise or anti-clockwise while carefully advancing the tube. Effortless intubation is the norm.

In order to disseminate this new method of using the C-MAC® D blade within our department, we designed and delivered a C-MAC® D blade multidisciplinary education programme. This consisted of e-mail circulation of the 'Bath C-MAC® D blade guide,' teaching this technique during three departmental out-of-theatre airway workshops for anaesthetists and anaesthetic assistants,[3] and running a 'Bath tea trolley' training programme to provide additional training in the workplace.[4]

During the three airway workshops, 129 members of staff were trained and all 'strongly agreed' or 'agreed' that the teaching was relevant and useful.[3] During the 'tea trolley' training programme, we trained 56 members of staff over three afternoons: 36 anaesthetists of all grades, and 21 anaesthetic assistants and students (Fig. 1). Before training, 56% (29/56) participants reported that they were either quite or very confident using a C-MAC® D blade, and after the 'tea trolley' training programme this increased to 96% (54/56) (Fig. 1). After training, 98% of participants felt that the training had improved their ability to manage a patient with a poor view at laryngoscopy safely, 100% recommended that the training be repeated, and 98% felt that other departments could benefit from similar teaching.

In summary, we believe that an alternative technique is required when using the C-MAC® D blade. Education of all members of the anaesthetic team may require multiple interventions including written information and practical sessions repeated frequently.

Authors' contributions

Delivery of teaching: ECR, NC, LC, TC, VT, FEK
Review of data: ECR, NC
Writing of manuscript: ECR, FEK
Review of final manuscript: NC, LC, TC, VT, TMC
Writing of D blade guide: TMC
Review of Bath CMAC D blade guide: FEK Concept and design of 'tea trolley teaching': FEK

Declarations of interest

The Bath Department of Anaesthesia has received free or at-cost airway equipment from numerous companies for evaluation or research. No author, nor their families, has any financial interest in any airway company. TMC is an associate editor of the *British Journal of Anaesthesia*. He has spoken at a Storz GmbH meeting about airway management and was not paid. All other authors declare no conflicts of interest.

References

1. Kelly FE, Cook TM. Seeing is believing: getting the best out of videolaryngoscopy. *Br J Anaesth* 2016; **117**: i9–13
2. Cook TM, Boniface NJ, Seller C, et al. Universal videolaryngoscopy: a structured approach to conversion to videolaryngoscopy for all intubations in an anaesthetic and intensive care department. *Br J Anaesth* 2018; **120**: 173–80
3. Aldridge M, Reynolds EC, Ballisat B, Kangesan I, Cook TM, Kelly FE. Development and evaluation of a handbook for out-of-theatre airway workshops, designed to standardise teaching and assist organisation. *Br J Anaesth* 2018; **121**: e4
4. O'Farrell G, McDonald M, Kelly FE. 'Tea Trolley' difficult airway teaching. *Anaesthesia* 2015; **70**: 104

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Two new algorithms for managing tracheostomy emergencies on the ICU

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Keywords: airway; capnography; emergency; human factors; intensive care unit; tracheostomy

Editor—The National Tracheostomy Safety Project (NTSP) was formed with the aim to improve the management of patients with tracheostomies, and produced their first multidisciplinary emergency management guidelines in 2012.[1] Tracheostomy emergencies on the ICU differ significantly to those in the rest of the hospital: in the ICU, a patient with a tracheostomy is often ventilator-dependent, capnography-monitored, and displacement is more common than obstruction.[2] These are less likely for a patient on a hospital ward, for whom problems with tracheostomy tube obstruction are more likely.

Algorithms specifically for the management of tracheostomy emergencies in ICU patients were designed in 2010[3] and included in the report of the Fourth National Audit Project (NAP4) in 2011.[2] We have recently redesigned these ICU tracheostomy emergency management algorithms (Fig. 1) emphasising the following: first, 'red flag' signs, indicating a possible tracheostomy problem to the multidisciplinary team and triggering an early call for assistance; second, 'yellow box' signs and actions, including capnography waveform recognition,[4] for ICU residents and senior nurses to implement while waiting for more senior help to arrive; third, details of who to call for help and how; and fourth, the removal of the tracheostomy inner tube and attempt at passing a tracheal suction catheter, to assist in diagnosing a tracheostomy problem and removal of any secretions blocking the tracheostomy. The redesign uses human factors and ergonomics design principles, including prompts for staff to 'declare an emergency', 'stop and think', and the use of a simple, clear colour-coded stepwise design. These algorithms are designed to be placed at the patient's bedhead, next to and in the same colour as the NTSP bedhead signs, so that they can be used in an emergency by all members of the team.

Our two algorithms have the following headings: 'tracheostomy: with patent upper airway' and 'laryngectomy: neck-ONLY breather' (Fig 1). The latter emphasises that, although all patients with tracheostomies are 'neck breathers', only the laryngectomy patient is an *obligate* neck breather.[5] We use a separate bedhead chart to indicate previous intubation ease or difficulty.

We familiarised staff with the redesigned algorithms using the 'tea trolley' method,[6] and provided 10–15 min teaching sessions for staff across disciplines using a low fidelity simulation tool. We trained 67 staff members including all grades of nurses and doctors. All participants (67/67, 100%) preferred the newly designed ICU tracheostomy emergency algorithms to the NTSP algorithm, reporting that they were clearer and easier to follow in an ICU emergency. All (67/67, 100%) participants recommended these algorithms and this training programme to other ICUs.

In summary, our ICU-specific algorithms are likely to assist multidisciplinary staff in the diagnosis and management of tracheostomy emergencies in the ICU. They emphasise capnography to diagnose the problem and to measure intervention success, and use human factors and ergonomics design principles. We believe that these algorithms are simpler and clearer than the NTSP ones and may be easier for staff to use in an emergency situation. The NTSP may wish to consider development of an ICU-specific algorithm.