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Airway management in space: a novice skill?

Eleanor M. Tanqueray[1,*], Danielle Eusuf[2], Emma L. England[2], Annie R. Pinder[2] and Clifford Shelton[3,4]

[1]North West School of Anaesthesia, Health Education England North West, Liverpool, UK, [2]North West School of Anaesthesia, Health Education England North West, Manchester, UK, [3]Lancaster Medical School, Faculty of Health and Medicine, Lancaster, UK and [4]Department of Anaesthesia, Wythenshawe Hospital, Manchester University NHS Foundation Trust, Manchester, UK

*Corresponding author. E-mail: eleanor.tanqueray@doctors.org.uk

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Editor—We enjoyed discussing the work of Starck and colleagues[1] at our recent virtual journal club based at the North West School of Anaesthesia, UK. We were fascinated to learn about research in parabolic flight microgravity and congratulate the authors on conducting a challenging study to compare simulated tracheal intubation using direct and videolaryngoscopy by experts and novices. The study concluded that there was no significant difference between novices and experts using a McGrath videolaryngoscope (Medtronic, Dublin, Ireland) when intubating the 'trachea' of a SimMan ALS manikin (Laerdal, Stavanger, Norway) in simulated microgravity. The accompanying editorial[2] raises some excellent points around the methodology of this study, to which we would like to add. Furthermore, we have some observations concerning skill acquisition and retention, which may offer some explanation for the interesting and perhaps surprising findings in Starck and colleagues'[1] paper.

Firstly, we wish to draw attention to the role of the airway assistant. It was important to include 'novice' participants in Starck's[1] study because long-duration spaceflights involve a not-inconsiderable risk of a medical emergency necessitating airway management. If required, this would need to be undertaken by members of the crew who may not be medically trained or experienced in tracheal intubation. Furthermore, because of the distances involved, real-time guidance from an expert on Earth would be impossible, so self-sufficiency would be required. We note, however, that whilst novices undertook the intubation attempt on 50% of occasions, the assistant for all attempts was described as an 'expert'. The role of the anaesthetic assistant is vital in emergency airway management, including providing equipment in an appropriate fashion, decision support, identification and mitigation of airway problems, and providing a degree of supervision for inexperienced anaesthetists.[3,4] Although this study simulated only a single task with little requirement for decision making, we wonder if the involvement of an expert assistant may have improved the chances of success in comparison to what may reasonably be expected in the spaceflight context.[1]

Secondly, we question the definition of 'failure' in Starck and colleagues'[1] study, which comprised misplacement of the tracheal tube (including endobronchial intubation), or a procedural duration that exceeded the duration of the parabola (25 s).[1] Whilst problems such as unrecognised oesophageal intubation clearly do represent 'failure', we question the appropriateness of this binary classification in other circumstances. Endobronchial intubation, for example, is easily rectified and can be lifesaving in an airway emergency. With this in mind, it would have been useful to know the reasons for failed intubation. Given the limited data that are presented it is possible, for example, that videolaryngoscopy mitigated the risk of endobronchial intubation as a result of improved visualisation of the tube markings, but that the results were otherwise the same.

Thirdly, the way in which skill levels are defined requires consideration. Whilst Starck and colleagues'[1] definition of 'experts' (>1000 tracheal intubations) is uncontroversial, defining those having completed less than 10 intubations before the study as 'novices' may not be accurate. The Dreyfus and Dreyfus model of skill acquisition defines five levels of skill: novice, advanced beginner, competent, proficient, and expert.[5] According to this system, novices lack the benefit of contextual knowledge. However, the less experienced participants in this study could reasonably be expected to have acquired this as a consequence of both prior intubation experience and the training course (including four tracheal intubations) provided as part of the study.[1] Relatively little experience is required to rapidly move through lower skill levels. It should therefore be considered whether the theoretical maximum of 13 intubations that 'novices' could have undertaken before the start of data collection may have

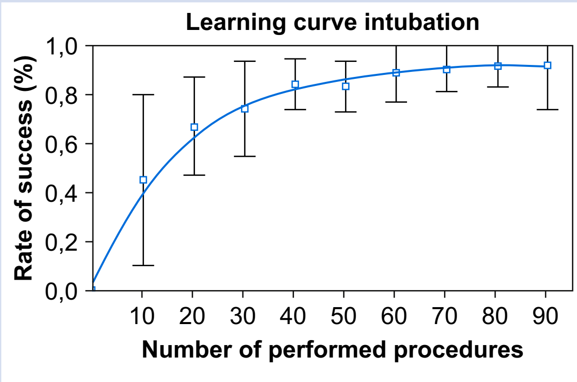

Fig 1. Konrad and colleagues'[6] learning curve of tracheal intubation, reproduced with permission.

yielded a degree of expertise sufficient to narrow the 'gap' between them and the experts. The Dreyfus and Dreyfus learning curve has been reproduced in the context of tracheal intubation by Konrad and colleagues,[6] indicating that by the time a trainee has undertaken 20 intubations a success rate of >60% can be expected (Fig. 1). In the UK, trainee paramedics are expected to complete 25 tracheal intubations, after which they are expected to achieve a first-pass intubation success rate of 90%.[7] On this basis, we suggest that the 'novices' were more properly 'advanced beginners', at least by the end of the trial. This raises the possibility that the study may be insufficiently powered to detect whether the difference between novices and experts truly 'vanishes' when using videolaryngoscopy in microgravity.[1] Furthermore, the repetitive use of a single type of manikin with predictable airway anatomy may have allowed novices to 'train to the test' more than would be possible in real clinical practice.

Finally, we considered the practical impact of the study in terms of training and skills retention. In addition to the challenges of training crew members to the required skill level, skills fade is a well-recognised manner; the retention of procedural skills including tracheal intubation has been found to decline significantly between 6 and 12 weeks after training amongst medical students with little or no experience.[8] This raises the question of how best to retain crew members' tracheal intubation skills in anticipation of an expected but rare event. In a similar fashion to anaesthetists' training for rare but catastrophic events such as 'cannot intubate, cannot oxygenate' or malignant hyperthermia scenarios, we suggest that refresher training drills would be required during a long space mission. A recent paper by Xiao and colleagues[9] proposes the use of a manikin-free virtual reality system to train medical professionals for neonatal tracheal intubation based on virtual models extracted from CT scans.[9] This method may yield benefits in the spaceflight context by obviating the need for a heavy and bulky manikin, and having the capacity to replicate multiple different airways (including, potentially, those of the crew) without increasing the weight of equipment required. In the future, virtual reality simulations could address the challenges of both skill retention and anatomical variation in the context of prolonged spaceflight.

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Declarations of interest

CS is a former member of the editorial board of *BJA Education*. The authors declare no other competing interests.

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