Professional attitudes to a 'smart' tracheal tube: report of a survey of Difficult Airway Society delegates in 2018

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The intra-Tracheal Multiplexed Sensing endotracheal tube (iTraXS) was developed in collaboration by the University of Nottingham, Nottingham University Hospitals, and P3 Medical Ltd (Preston, UK), and funded by the National Institute for Health Research's i4i programme (II-LA-0813-20008; see Fig. 2). iTraXS allows continuous monitoring of multiple core standard physiological parameters such as temperature and oxygen saturations, and a range of novel cardiovascular data, including tracheal mucosal contact pressure and mucosal ischaemia. The potential benefits of such technology include reduced tracheal mucosal injury, reduced micro aspiration, reliable central monitoring, and confirmation of tracheal placement.

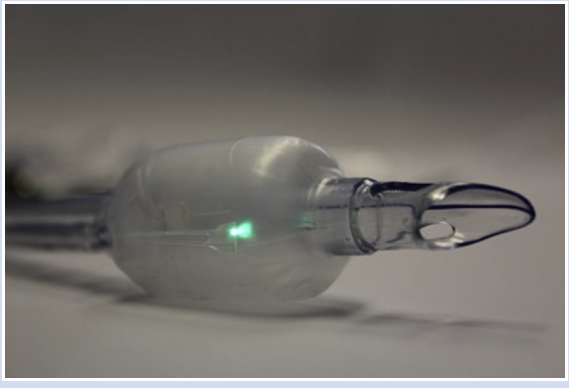

Fig 2 The intra-Tracheal Multiplexed Sensing endotracheal tube (iTraXS)

The Difficult Airway Response Team programme: a 10-yr follow-up

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Failures of airway management are a major source of morbidity, mortality, and hospital liability. We previously described the implementation of the Difficult Airway Response Team (DART) programme, a multidisciplinary collaboration between anaesthesiologists, otolaryngologists, emergency physicians, and trauma surgeons.[1–3] We report on aspects of the 10 yr experience of the DART programme.

This institutional review board (IRB)-approved study included all events for which DART was activated to manage adult patients from July 2008 to July 2018. The DART database was used to collect demographic and event data, including intubation technique and success or failure of each attempt. χ^2 testing with pairwise Bonferroni correction ($P \leq 0.05/6 = 0.0083$, statistically significant) was used to compare intubation technique success rates. Linear regression was used to model the change in technique prevalence over time.

During the period studied, 729 DART activations were recorded (57.8% males, mean [standard deviation, SD]; age: 55.6 [16.7] yr). The predominant locations for DART activation were intensive care units (n=373, 51.1%) and the emergency department (n=143, 19.6%). Of 729 patients, 125 (17.1%) were transported to the operating room for management. Risk factors for DART activation included known difficult airway, angioedema, current tracheostomy, airway bleeding, and BMI >30 kg m^{-2}. The primary techniques used were videolaryngoscopy (VL), direct laryngoscopy (DL), fibreoptic bronchoscopy (FOB) techniques, rigid laryngoscopy (RL), and surgical airway; supraglottic airway was used as part of airway management in 58 (8.0%) activations. Linear regression showed a significant increase over time in the percentage of attempts with VL (slope=3.0% yr^{-1}, 95% confidence interval=1.8–4.2%, P=0.0005). χ^2 analysis revealed higher rates of success for FOB techniques (133/179, 74.3%) than for either DL (143/277, 51.6%) or VL (142/267, 53.2%) (P<0.00001 for both). RL (48/74, 64.9% successful) was associated with higher success rates than DL (P=0.04) or VL (P=0.07), but these results were not significant after Bonferroni correction. Overall, 56 (7.7%) patients required a surgical airway (cricothyrotomy or tracheostomy). No airway-related mortalities occurred during DART activations.

The DART programme has successfully prevented airway-related mortality. Despite the increasing use of VL, other techniques, including surgical airways, continue to be invaluable for patient safety. Institutions should consider customising the DART programme to optimise their clinical practice.

References

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Paediatric emergency front-of-neck access: accuracy of cricothyroid membrane identification and hypothetical incision lengths

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The cricothyroid membrane (CTM) is the recommended site for emergency front-of-neck access (eFONA) in children in a cannot intubate, cannot oxygenate (CICO) scenario. We investigated the following: (1) accuracy of ultrasound in identification and measurement of CTM dimensions; (2) clinician accuracy in CTM localisation by palpation; and (3) the starting point and length of different hypothetical vertical incision strategies required to expose the CTM.

The study was a prospective observational study performed in a tertiary paediatric university hospital. Ethical

Table 1 Clinician accuracy and hypothetical incision lengths.

	0–1 yr old	1–8 yr old	9–16 yr old
Subjects	14	58	25
Total assessments	17	63	34
Clinician accuracy (%)	29	296	38
Inaccuracy range (mm) (above to below CTM)	13.2 (+5.7 to −7.5)	30.3 (+8.6 to −21.7)	38.4 (13.2 to −25.2)
Incision lengths (mm)			
Clinician estimate	15	45	55
Neck midpoint	20	30	35

approval was granted by the hospital research ethics committee (REC Ref: GEN/596/17). (1) CTM height measured by ultrasound was compared with that measured by MRI (n=22). (2) We assessed clinician (anaesthesiologist) accuracy in CTM localisation by digital palpation using ultrasound as a reference standard (n=97). (3) We estimated hypothetical eFONA vertical incision lengths required for CTM exposure based on three incision commencement points (clinician estimate of CTM location, the suprasternal notch, and the neck midpoint). A vertical incision that would expose any portion of the CTM was considered successful. All assessments were performed in the extended neck position in ASA physical status 1 and 2 children undergoing elective general anaesthesia.

(1) CTM height measured by ultrasound correlated well with that measured using MRI (r=0.98; 95% confidence interval [CI], 0.95–0.99; P<0.0001). Data for (2) and (3) were analysed according to age group (0–1, 1–8, and 9–16 yr old). (2) Clinician accuracy was 29%, 29%, and 38% by age group and did not differ with clinician experience or repetition. (3) Hypothetical incision lengths varied by both age group and by starting point (Table 1). The smallest incision was projected using clinician estimate of CTM location in the 0–1 yr old group and using the neck midpoint in the other groups.

Bedside ultrasound is accurate for the measurement of paediatric CTM height. Clinician accuracy was low in paediatric CTM localisation across age groups. Optimum eFONA incision strategy varied by age group.

Categorical data are presented as n (%). Continuous data are presented as median (range). Incision lengths are rounded to nearest 5 mm. Clinician estimate incisions utilise the clinician estimate of CTM location as midpoint of incision. Neck midpoint incisions use the midpoint of the neck as the starting point of the incision.

Optimising videolaryngoscope use: a video-assisted flexible-optical intubation and CMAC® D blade multidisciplinary training programme

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Universal videolaryngoscopy has been used in our hospital since 2017.[1] Optimising videolaryngoscope (VL) use has involved disseminating Video-Assisted Flexible-Optical Intubation (VAFI)[1] and a specific technique for using the CMAC® D blade (KarlStorz, Slough, UK) using a rigid KarlStorz stylet.[2] VAFI is a two-person intubation technique that can be used when the larynx is visualised using a hyperangulated VL but a tracheal tube cannot be passed despite using a stylet: intubator one optimises the laryngeal view using a hyperangulated VL blade; intubator two (standing next to and to the right of intubator one) preloads a tracheal tube onto a flexible bronchoscope, guides the bronchoscope into the trachea, and then railroads the tracheal tube over the bronchoscope into place. This technique can be used electively for an anticipated difficult intubation or as a rescue technique in a 'can't intubate, can oxygenate' situation.

We designed and delivered a VAFI and CMAC® D blade training programme for our department: a CMAC® D-blade/VAFI guide was disseminated by e-mail; VAFI and CMAC® D blade stations were included in out-of-theatre airway workshops; a 'Bath Tea Trolley' training programme provided multidisciplinary VAFI and CMAC® D blade training in the workplace during the normal working day, using a previously described teaching method.[3] Participants were given hand-outs to facilitate reflective learning and completed a feedback form.

Fifty-four staff members received training: 17 consultants, five associate specialists, eight registrars, nine core trainees/clinical fellows, and 15 anaesthetic assistants/students. Results showed that before training, 31 of 54 (57%) participants reported that they were quite/very confident in CMAC® D-blade use and 16 (30%) for VAFI; after training, 44 (82%) of participants reported an increase in confidence of ≥1 on a 5-point Likert scale for CMAC® D blade use and 48 (89%) for VAFI; 94% of participants reported that their ability to manage a difficult airway would be improved after this training; 100% of participants requested that this training be repeated in Bath; 100% recommended this training to other hospitals. Confidence scores before or after training are shown in Figure 3.

In summary, optimising videolaryngoscopy has involved dissemination of VAFI and CMAC® D blade techniques using a multimodal approach. 'Tea trolley' training proved very

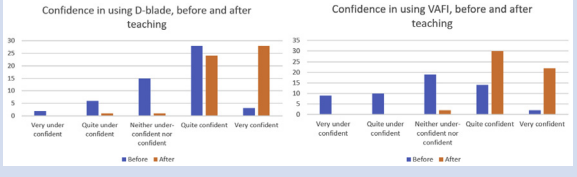

Fig 3 Confidence levels before and after training