Can't intubate, can't ventilate! A survey of knowledge and skills in a large teaching hospital

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Background and objective **The Difficult Airway Society protocol for the 'can't intubate, can't ventilate' scenario recommends the use of kink-resistant cannula cricothyroidotomy with transtracheal jet ventilation or surgical cricothyroidotomy. This survey aimed to assess the preparedness of anaesthetists and anaesthetic assistants for emergency tracheal access.**

Methods **Ninety-seven anaesthetists and 63 assistants were asked the location of the two difficult airway trolleys. The anaesthetists were asked for their choice of emergency tracheal access. Those opting for cannula cricothyroidotomy with jet ventilation were asked to demonstrate cannulation of a mock trachea. After insertion of the airway cannula, the time required to attach the jet ventilator to the anaesthetic machine oxygen outlet and insufflate a dummy lung was recorded. The time to connect to a jet ventilator was also recorded for assistants.**

Results **Five (5.2%) anaesthetists and 18 (28.6%) assistants knew the location of both airway trolleys. Sixty-one (62.9%) anaesthetists and one (1.6%) assistant did not know the location of either airway trolley. Thirty-six out of ninety-seven (37.1%) anaesthetists chose a method of tracheal access in keeping with Difficult Airway Society guidelines. Thirty-six out of ninety-seven (37.1%) anaesthetists opted for the jet ventilator, but 15 of these 36 (41.7%) could not locate the appropriate oxygen outlet on the anaesthetic machine. The median time [interquartile range (range)] to insufflate the dummy lung for the remaining 21 anaesthetists was 30 [23–32 (5.5–60)] s.**

Conclusion **There were widespread deficits in 'can't intubate, can't ventilate' knowledge and skills. All participants received a demonstration of equipment, were shown the location and given the opportunity to rehearse a 'can't intubate, can't ventilate' drill. *Eur J Anaesthesiol* 26:480–483 © 2009 European Society of Anaesthesiology.**

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Introduction

The can't intubate, can't ventilate (CICV) scenario is a rare but feared emergency situation for all anaesthetists. This fear is justified, as tracheal intubation difficulties are the most common cause of hypoxic anaesthetic death and brain damage [1,2]. In fact, the Difficult Airway Society (DAS) estimates that at least 20 patients per year die as a result of a loss of airway in anaesthetic and ICU practice in the UK [3]. Guidelines for the difficult airway have been developed in several countries by national societies [4–6], and the DAS has similarly developed guidelines for the nonobstetric patient, which include a protocol for a CICV situation. Similar to all other current airway guidelines, it recommends the use of either a kink-resistant cannula cricothyroidotomy with percutaneous transtracheal jet ventilation or surgical cricothyroidotomy [4–7]. Moreover, several studies have established a 40 s threshold for the time taken for insertion of the cricothyroidotomy device to tracheal insufflation [8]. The purpose of this survey was to assess the readiness of anaesthetists for this eventuality. A further aim was to establish whether anaesthetic assistants would be able to help effectively.

Methods

This survey was undertaken in a busy teaching hospital with a department of approximately 80 anaesthetists at any one time. Numbers vary because of frequent rotation of trainees between departments and other hospitals. Local Research Ethics Committee approval was not required after discussion with the local ethics committee. Participants were able to decline involvement; one person did so. Voluntary participants were not informed beforehand because of the requirement for immediate, unprepared responses, the sort required for a CICV situation.

There is a main theatre suite of 14 theatres (including two emergency theatres), which has one difficult intubation trolley. There is also a plastic surgery theatre suite comprising six theatres (including one emergency theatre) with another difficult intubation trolley. These suites adjoin each other, and all anaesthetists and assistants are expected to be able to work in either suite. Each trolley contains jet ventilation catheters (VBM Medizintechnik, Sulz, Germany), Portex Minitrach devices (SIMS Portex Inc., Hythe, Kent, UK), Seldinger catheters as well as

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surgical tracheotomies. A handheld Manujet III jet ventilator (VBM Medizintechnik) is present in each trolley. One attaches to the wall-mounted Schrader sockets for an oxygen supply, but the jet ventilator in the main theatre suite attaches to the small four-bar connector (mini-Schrader) at the back of the Aestiva/5 (GE Healthcare) ventilators which are used throughout the theatre suites.

Over a period of 8 weeks, 97 anaesthetists were approached randomly and, having given verbal consent, were asked about their own experiences of emergency cricothyroidotomy. They were asked for the location of the difficult intubation trolleys and the types of airway devices available. They were then asked what they would use to obtain urgent tracheal access in a CICV situation in the main theatre suite. They were not given a list but were required to state in their own words their tracheal device of choice and method of ventilation, thereby mimicking a real-life request. The anaesthetists who requested a cannula for cricothyroidotomy with the jet ventilator were asked to demonstrate the insertion of the jet ventilator catheter or 14 g intravenous cannula (depending on their choice) into a mock cricothyroid membrane. They were then told suddenly that this was a CICV situation, the patient was desaturating, and that a timer had started. The time taken for specifically attaching the main theatre suite Manujet III to both the tracheal cannula and the mini-Schrader valve on the anaesthetic machine was recorded using a stopwatch. Insufflation of a dummy lung was used as the endpoint. Of interest, the mock cricothyroid membrane was made from standard plastic breathing circuit tubing. As criciothyroid puncture was not the main point of this exercise, and was not timed, it was not necessary to obtain a more realistic mannequin.

Alongside the survey of anaesthetists, 63 anaesthetic assistants were similarly asked the location of the difficult intubation trolleys. They were not asked to demonstrate insertion of a needle cricothyroidotomy cannula but, similar to the anaesthetists, were asked to connect the jet ventilator to both the patient and the anaesthetic machine and insufflate the dummy lung, again mimicking a potential real-life request. This was also timed. Each participant was asked to conceal the nature of the test in order to gain a true reflection of participants' knowledge and skills. Data were anonymized. Recorded times are given as a median [interquartile range (range)]. Statistical comparison of anaesthetist and assistant jet ventilator connection times was undertaken using a Wilcoxon rank-sum test. A chi-squared test was used to compare DAS guideline compliance between consultants and trainees and also for the association between guideline compliance and recent airway course attendance. A Fisher's exact test was used to test for association between disconnecting the oxygen supply and recent airway course attendance.

Results

Forty-four consultants, 23 specialist registrars and 30 senior house officers participated. The average number of years in anaesthetics was 16.5, 7.3 and 3.8, respectively. Of the 97 anaesthetists, 10 (10.3%) had performed a total of 13 emergency cricothyroidotomies with four immediate failures and subsequent deaths. Another four (4.1%) had required a surgeon to perform an emergency tracheostomy for a CICV situation.

Table 1 illustrates both anaesthetist and assistant deficits in knowledge of location of difficult airway trolleys. Ten (10.3%) anaesthetists could name two types of device available for tracheal access in a CICV situation. Twenty (20.6%) could name one device available, but the majority (69.1%) could not name any of the devices available. Of the 63 anaesthetic assistants, seven (11.1%) knew of one device available, and the rest (88.9%) could not name any device.

Thirty-six anaesthetists (37.1%) chose a method of urgent tracheal access that complied with recommendations, that is, a kink-resistant cannula with jet ventilator or surgical airway (Table 2). Forty-five and a half percent of consultants adhered to recommendations as compared with 30.2% of trainees, although this was not a statistically significant difference ($P = 0.12$). Of note, 31 (32%) anaesthetists had undertaken a difficult airway course in the previous 4 years, with a significant association between having done so and complying with DAS guidelines ($P = 0.013$).

The 36 anaesthetists (Table 2) who opted for the jet ventilator were asked to demonstrate insertion of their preferred tracheal device and were timed on connecting the jet ventilator. Of these 36, 15 (41.7%) could not locate

Table 1 Knowledge of location of difficult airway trolleys

	n	Only knowing location of main suite trolley	Only knowing location of plastic surgery suite trolley	Knowing location of both trolleys	Not knowing either
Consultants	44	12	3	4	25
SpRs	23	5	1	0	17
SHOs	30	9	1	1	19
All grades	97	26	5	5	61
Assistants	63	42	2	18	1

SHOs, senior house officers; SpRs, specialist registrars.

Table 2 Methods of tracheal access and ventilation in a can't intubate, can't ventilate situation

	Cons (44)	SpR (23)	SHO (30)	Total (97)
'Cricothyroidotomy set'[a] and JV[b]	10	2	7	19
Jet ventilator catheter and JV[b]	6	2	1	9
Scalpel and small tracheal tube[b]	3	3	0	6
Scalpel and small tracheostomy tube[b]	1	0	1	2
14 g intravenous cannula and JV	3	1	4	8
Other methods	21	15	17	53

Cons, consultants; JV, jet ventilator (Manujet III); SHO, senior house officer; SpR, specialist registrar. [a] Anaesthetist unable to name specific cricothyroidotomy set on trolley. [b] Denotes in line with Difficult Airway Society guidelines.

the oxygen supply outlet for the jet ventilator and abandoned the attempt. The median time of the remaining 21 anaesthetists according to grade is shown in Table 3. Of the same 36, 11 (30.6%) disconnected the main oxygen supply to the anaesthetic machine at some point while trying to locate the mini-Schrader oxygen valve, five were ultimately successful and six belonged to the group of 15 that abandoned the attempt. Two did not realise until the disconnection alarm sounded; one had by this time found the mini-Schrader but was unable to insufflate the dummy lung because of the failure to reconnect the main oxygen supply.

Of the 15 anaesthetists who opted for the jet ventilator and were unable to find the correct oxygen outlet, six had been on a recent difficult airway course. Of the 21 anaesthetists able to find the correct oxygen outlet, 11 had been on a recent difficult airway course. There was no significant association between these variables ($P = 0.5$). Further analysis revealed that of the 21 anaesthetists able to connect the jet ventilator correctly, only 10 (27.8% of all anaesthetists who requested the jet ventilator) would be able to locate a difficult intubation trolley and hence obtain the jet ventilator in an emergency.

Twelve of the 63 (19%) anaesthetic assistants could not locate the oxygen outlet for the jet ventilator and abandoned the attempt. The time for the remaining 51 assistants is shown in Table 3. Twelve of the 63 (19%) assistants disconnected the main oxygen supply while trying to find the correct outlet.

Table 3 Number of anaesthetists and anaesthetic assistants who could not connect the jet ventilator and the median times to connect it for those able to do so

	Who failed to locate the O_2 supply outlet for the JV	Time (s) to successfully connect the JV and insufflate the lung, median [IQR (range)]
Consultants	8/19	30
SpRs	1/5	34
SHOs	6/12	22.8
All anaesthetists	15/36	30 [23–32 (5.5–60)][a]
Assistants	12/63	28 [17.4–39 (9.1–98)][a]

IQR, interquartile range; JV, jet ventilator; SHOs, senior house officers; SpRs, specialist registrars. [a] No difference between connection times for anaesthetists and assistants ($P = 0.74$).

Discussion

Fourteen out of 97 (14.4%) anaesthetists had experienced a CICV situation that required their own cricothyroidotomy or a tracheostomy performed by a surgeon. This compares favourably with a postal survey of 971 Canadian anaesthetists [9] in which 56.8% of respondents had encountered a CICV situation. The difference in CICV rates could be explained in part by the fact that the 47% postal return rate may have included a higher proportion of anaesthetists who have experienced a CICV scenario than in the nonresponders. Moreover, in this survey, there may have been a tendency of underreporting because of the direct nature of questioning. It is conceivable, however, that the incidence of the CICV situation may increase because of the decline of exposure to training because of European Working Time Directive constraints.

The present survey has demonstrated that there were several areas for improvement in the department. Nearly two-thirds of anaesthetists did not know where to locate any equipment for difficult and failed intubation. It is an important point that the knowledge of location of only one trolley is inadequate in that an unacceptable distance between theatre suites may have to be travelled depending on the theatre involved. Data also prove that assistants could not be relied upon universally to find the closest airway trolley. The majority of anaesthetists and assistants were also unaware of the range of tracheal devices available. It is arguable whether a department should be blamed for this systematic lack of knowledge or whether personal responsibility should necessitate acquisition of local knowledge of equipment that can save lives. Since this survey, groups of anaesthetists new to the department are shown the difficult airway trolleys, but individuals will still be missed.

The DAS guidelines by their own admission do not constitute a minimum standard of practice, nor are they to be regarded as a substitute for good clinical judgement [7]. However, expert opinion is quite clear about the methods of choice for urgent tracheal access in the CICV

situation, and national societies in several countries agree [1–3].

With respect to the choice of tracheal access, it was surprising that, in view of the relatively recent publication of the DAS guidelines, a majority of anaesthetists deviated from the advice. A popular device for tracheal access was the 14 g intravenous cannula. This deviates from the guidelines insofar as it is not kink-resistant. A common view was that anaesthetists would use this because of familiarity and proximity reasons, stating that they would not want to waste time waiting for the difficult airway trolley to arrive. It is easy to understand that, in the face of confusion over location and the type of airway equipment available, a 14 g intravenous cannula may be the only device readily available.

Approximately 40% of anaesthetists who requested the jet ventilator and 20% of all anaesthetic assistants could not locate the correct oxygen outlet. The participants who achieved successful ventilation of the dummy lung took a median of 28 s to complete the task. One participant demonstrated that it could be done in just 5.5 s. The reasons for delay were partly a lack of familiarity with the airway device connection but mainly the location of the oxygen outlet on the anaesthetic machine. Unfortunately, this in part stems from the nonstandardization of jet ventilator connectors but again mainly from lack of familiarity because of rarity of use.

Evidence suggests that there should be a threshold of 30–40 s for the time taken to insert a cricothyroidotomy device and insufflate the lungs [8]. A simplified surgical cricothyroidotomy technique can also be performed in 30 s [10]. It is easily apparent that 28 s for merely attaching a jet ventilator encroaches significantly on the time allotted for the entire procedure.

Although lack of knowledge of location, type and function of airway equipment is not ideal, one can certainly imagine a scenario in which problems with all these individual steps in managing a CICV situation line up similar to the holes in Reason's Swiss cheese [11] to end in an airway disaster.

The survey found that having undertaken a recent airway course was positively correlated with increased DAS guideline adherence. Perhaps by undertaking a formal airway course, one might expect increased knowledge and skill retention. However, a simpler method of increasing departmental exposure to equipment and its location may be by simply encouraging the use during elective difficult airway cases. At the very least, all participants in this survey have been shown the location of equipment and received a demonstration of all devices. They were also reminded of DAS guidelines and allowed to rehearse a CICV drill.

In conclusion, this survey demonstrated that the majority of anaesthetists and assistants are ill-prepared for a CICV situation. Despite guidelines, there was a wide variety of opinion on what constitutes an effective method of urgent tracheal access and ventilation in a CICV situation. For those who did choose an acceptable method, transtracheal jet ventilation could not be delivered in a timely manner. The CICV situation is rare, and this is the likely reason that, overall, participants underperformed. Although these survey results are representative of this institution, it would be remiss to assume that other hospitals do not have similar shortcomings.

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