The incidence, success rate, and complications of awake tracheal intubation in 1,554 patients over 12 years: an historical cohort study

Incidence, taux de réussite et complications de l'intubation trachéale chez 1554 patients éveillés sur une période de 12 ans: une étude de cohorte historique

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Abstract

Purpose Awake tracheal intubation is one recommended option to address select situations in the management of a patient with an anticipated difficult airway. A scarcity of data exists on how often awake intubation is performed or whether its use is changing over time, particularly with the increasingly widespread availability of video laryngoscopy. This retrospective database review was undertaken to determine the incidence, success, and complications of awake intubation and the incidence of other tracheal intubation techniques in the operating room over a 12-yr period (2002–2013) at our institution.

Methods The Anesthesia Information Management System in use at a Canadian tertiary care centre was searched for all awake intubations that occurred during the years 2002–2013. Records were also searched to identify

airway methods other than direct laryngoscopy that may have been used after the induction of general anesthesia. Changes in both the incidence of awake intubation and in the use of video laryngoscopy over the 12 years were analyzed using linear regression modelling.

Results Of 146,252 cases performed under general anesthesia with endotracheal intubation, 1,554 intubations (1.06%) were performed awake. There was no significant change in the rate of awake intubation over the studied years (slope -1.4^{-4} incidence-year $^{-1}$; 95% confidence interval [CI]: -3.0^{-4} to 3.0^{-5} ; $P = 0.102$). The relatively steady rate of awake intubation occurred despite a significant increase in the use of video laryngoscopy over the same time (slope 0.080 incidence-year $^{-1}$; 95% CI: 0.076 to 0.083; $P < 0.001$), particularly from 2009 onwards. Attempted awake intubation failed in 31 (2%) of the cases. Self-reported complications occurred in 15.7% of successful procedures. In addition, in a convenience sample of three years (2011–2013), the rate at which each of 49 attending staff performed awake intubation varied widely from 0–3.4 awake intubations per 100 cases of general anesthesia with endotracheal intubation.

Conclusions At our tertiary care centre, we did not find a significant change in the use of awake tracheal intubation over the studied years 2002–2013 despite increasing availability and use of video laryngoscopy. It appears that awake tracheal intubation retains an important and consistent role in the management of the difficult airway.

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Résumé

Objectif L'intubation trachéale du patient éveillé, qu'on appelle aussi intubation vigile, est une alternative recommandée dans certaines situations précises pour

prendre en charge un patient présentant des voies aériennes anticipées comme étant difficiles. Il n'existe que très peu de données concernant la fréquence à laquelle on réalise une intubation vigile ou si son utilisation change au fil du temps, particulièrement au vu de la disponibilité de plus en plus répandue de la vidéolaryngoscopie. Cette revue rétrospective de base de données a été entreprise afin de déterminer l'incidence, le taux de réussite et les complications liées à l'intubation chez le patient éveillé ainsi que l'incidence d'autres techniques d'intubation trachéale en salle d'opération au cours d'une période de 12 ans (2002-2013) dans notre centre.

Méthode Le système de gestion de l'information en anesthésie utilisé dans un centre de soins tertiaires canadien a été analysé pour en tirer tous les cas d'intubations vigiles survenus entre 2002 et 2013. On a également étudié les dossiers pour déterminer les méthodes de prise en charge des voies aériennes autres que la laryngoscopie directe qui pourraient avoir été utilisées après l'induction de l'anesthésie générale. Les changements dans l'incidence d'intubations vigiles et l'utilisation de la vidéolaryngoscopie au cours de ces 12 ans ont été analysés à l'aide d'un modèle de régression linéaire.

Résultats Sur les 146 252 cas réalisés sous anesthésie générale avec intubation endotrachéale, 1554 intubations (1,06 %) ont été réalisées chez un patient éveillé. Aucun changement significatif du taux d'intubations vigiles n'a été observé au cours de la période à l'étude (pente $-1,4^{-4}$ incidence-année $^{-1}$; intervalle de confiance [IC] 95 %: $-3,0^{-4}$ à $3,0^{-5}$; $P = 0,102$). Le taux relativement stable d'intubations vigiles peut être observé malgré l'augmentation significative de l'utilisation de vidéolaryngoscopie au cours de la même période (incidence 0,080 incidence-année $^{-1}$; IC 95 %: 0,076 à 0,083; $P < 0,001$), particulièrement à partir de 2009. Les tentatives d'intubation vigile ont échoué dans 31 (2 %) cas. Des complications auto-rapportées sont survenues dans 15,7 % des interventions réussies. En outre, dans un échantillon de commodité de trois ans (2011-2013), le taux auquel chacun des 49 patrons a réalisé des intubations vigiles a grandement varié, allant de 0 à 3,4 intubations par 100 cas d'anesthésie générale avec intubation endotrachéale.

Conclusion Dans notre centre de soins tertiaires, nous n'avons pas trouvé de changement significatif dans l'utilisation de l'intubation trachéale vigile au cours de la période étudiée (2002-2013), malgré la disponibilité et l'utilisation croissantes de la vidéolaryngoscopie. Il semble que l'intubation trachéale vigile garde un rôle important et constant dans la prise en charge de voies aériennes difficiles.

Awake tracheal intubation can be defined as the placement of an endotracheal tube (ETT) prior to the induction of general anesthesia. Canadian and American guidelines acknowledge awake intubation as an option for management of the patient with an anticipated difficult airway.^{1,2} Awake intubation can provide an extra margin of safety by allowing the patient to maintain gas exchange, airway patency, and protection against aspiration during the procedure. Besides anticipated difficulty with tracheal intubation itself, a decision to proceed with awake intubation often relates to concomitant predictors of difficulty with bag and mask ventilation, use of a supraglottic device (SGD), or obtaining an emergency surgical airway.³ The presence of a full stomach, likely intolerance of apnea, or the absence of skilled assistance may also impact the decision.¹

Successful and well-tolerated awake tracheal intubation requires a cooperative patient and excellent local anesthesia of the oropharynx, larynx, and trachea. The procedure can be facilitated by a judicious degree of systemic sedation. Although the flexible bronchoscope has traditionally been the most frequently used device to facilitate awake intubation, rigid video laryngoscopy (VL) has recently been described to facilitate awake intubation with comparable success.⁴⁻⁶

The well-performed awake intubation is a complex interaction of appropriate case selection, good patient preparation, and technical expertise in performing the procedure. It is a skill that should be acquired and maintained by all anesthesiologists. Nevertheless, as the need for awake intubation is relatively infrequent, few opportunities exist to acquire skills and maintain competence. This could be problematic, as a lack of confidence in performing awake intubation when significant difficulty is predicted could potentially lead to a less safe decision to induce general anesthesia before securing the airway. This tendency might be compounded by an overreliance on the efficacy of VL in addressing anatomic predictors of difficult direct laryngoscopy (DL).

Little information exists on how frequently awake tracheal intubation is used or whether its incidence is changing over time. Many clinicians have the impression that they are performing fewer awake intubations than in years past. A recently published analysis of 317,509 cases performed under general anesthesia at a hospital in the United States documented decreasing use of "fiberoptic intubation" over 12 years ending in February 2013, mirrored by an increase in the use of VL.⁷ Nevertheless, it was unclear from that report whether the use of fiberoptic intubation related only to awake intubation or included its use after the induction of general anesthesia. When directors of anesthesia residency training programs and

continuing education officers are establishing optimal training regimens and professional development offerings, it would be useful for them to know how often awake tracheal intubation occurs and whether its incidence might be changing.

The primary purpose of this study was to determine the annual incidence of awake tracheal intubation and whether it had changed over the period 2002–2013. The null hypothesis was that the incidence of awake tracheal intubation had not changed significantly over this time period. As a secondary outcome, we determined how frequently alternatives to DL (such as VL) were used in each of the studied years to facilitate tracheal intubation after the induction of general anesthesia. Furthermore, we determined the success rate as well the incidence and type of reported complications for the identified attempted awake intubations.

Methods

This was a retrospective database review involving the Anesthesia Information Management System (AIMS) used in our operating rooms. The study was approved in January 2014 by the Research Ethics Board at the Capital District Health Authority in Halifax, NS. The requirement for individual patient consent to access personal health information was waived. The study included data from cases performed at the QEII Health Sciences Centre (an adult tertiary care institution performing most surgeries apart from obstetric and non-oncologic gynecologic procedures) from January 1, 2002 to December 31, 2013. An AIMS was in use for the entire time period, Saturn Information System from January 2002 to September 2010 and Innovian[®] Anesthesia from September 2010 to December 2013 (both Draeger Medical Inc., Telford, PA, USA).

The AIMS was electronically searched for all cases performed under general anesthesia. Of these, only cases involving transoral or transnasal tracheal intubation were further assessed - those performed with face mask ventilation, an SGD, or awake tracheostomy were excluded from analysis. To identify cases of awake tracheal intubation, Excel (Microsoft Corporation, Redmond, WA, USA) spreadsheets of the general endotracheal anesthesia (GETA) cases retrieved from the AIMS records were downloaded and separated into calendar years. After assessment of the total number of cases performed under GETA, each year was searched in all fields using the Excel “Find” function for the following key words or terms: *awake intubation, awake fiberoptic, awake fiberoptic, awake fiber optic, awake bronchoscopic, awake, aware, tracheal intubation, fibre-optic, topical,*

tetracaine, SLN, superior laryngeal, gargle, paste, ointment, ungt, AFI, AFO, FB, FOB, FOI, pledg[ets], piriform, Kraus[e][forceps], Jackson [forceps], DeVil[biss], visc[ous], hurric[aine], atomi[zer], nebuli[zer], aerosol, transtrach[eal], fiberoptic, fiberoptic, bronchoscopic, EMLA. Lidocaine and Xylocaine were excluded as search terms due to their frequent recorded use for indications other than awake intubation. All retrieved entries were then manually assessed to confirm whether awake intubation had indeed been attempted. Awake intubation cases were pasted to a new spreadsheet for each studied year in order of date performed.

Data on each year’s awake intubation spreadsheet were then examined to confirm the absence of duplicate entries for the same case by comparing unique numeric patient and case identifiers, surgery date, and surgery start times. The text for each retained entry was then re-reviewed in its entirety to determine the ultimate success of an attempted awake intubation, number of attempts, and nature of any recorded complications. For all identified cases of awake intubation, patient demographic information was retrieved from the same spreadsheet, including age, sex, and surgical procedure.

A second search of the initially retrieved AIMS GETA records was performed for each year to assess use of VL and non-VL alternatives to DL after induction of general anesthesia. Video laryngoscopes in use during some or all of the studied time period included the GlideScope[®] (Verathon Inc., Bothell, WA, USA), the Storz C-MAC[®] with Macintosh and D-Blades (Karl Storz Endoscopy America Inc., El Segundo, CA, USA), McGRATH[®] Series 5 (Aircraft Medical Ltd., Edinburgh, UK), Pentax-AWS[®] (Hoya Service Corp., Tokyo, Japan), and King Vision video laryngoscope (Ambu Inc., Glen Burnie, MD, USA). Non-VL alternatives included the Trachlight[™] lighted stylet (Laerdal, Wappingers Falls, NY, USA – product discontinued 2009), Clarus Medical’s Shikani, Levitan, and Video system viewing stylets (Clarus Medical, Minneapolis, MN, USA), the Bullard[™] laryngoscope and the LMA-Fastrach[™] (Teleflex, Research Triangle Park, NC, USA). Brand and generic terms for these devices were searched for frequency of use. During this data extraction, no distinction was made between use of a device for an actual difficult intubation situation or for skills maintenance or teaching purposes. Use of flexible bronchoscopy in the induced patient was not assessed during this search component due to its overlapping roles in tracheal intubation, in positioning a double-lumen tube or bronchial blocker, and in both anesthesia- and surgical-related diagnostics.

Lastly, we studied a convenience sample of three years (2011–2013) to obtain information on how often individual attending anesthesiologists had performed an awake

intubation. Anesthesiologists were included only if they had worked clinically for at least a full-time equivalent of 0.6 for all three years. Their individual rates of awake intubation were determined.

Changes in awake intubation and VL incidence over time were analyzed by examining their rates of use in six-month time intervals using linear regression analysis with time intervals as the independent variables. Slope estimates (representing the incidence-year⁻¹), *P* values, and the respective confidence intervals are reported for model results. Descriptive statistics (mean or median

[interquartile range]) are presented for observations on patient age, staff awake intubation rates, and staff experience. Data were analyzed using R 3.1.1 statistical software (R Foundation for Statistical Computing, Vienna, Austria).⁸

Results

From January 1, 2002 to December 31, 2013, 205,623 cases were performed under general anesthesia. Of these, 59,371 cases (29%) were performed with an SGD, face mask ventilation, or awake tracheostomy. Oral or nasal tracheal intubation occurred in the remaining 146,252 (71%), and awake tracheal intubation was performed in 1,554 (1.06%) of these cases. Five hundred twenty (33.5%) of these patients were female and 1,034 (66.5%) were male. The mean (interquartile range [IQR]) age was 55 [45-66] yr. The youngest patient was 16 yr old and the oldest patient was 97 yr old. Details of the patients' surgical procedures appear in Table 1. Eighteen cases retrieved using the keyword search parameters could not be confirmed as awake intubations during the manual review; consequently, they were excluded from awake group analysis but retained in the denominator totals.

The 1.06% overall incidence of awake intubation ranged from 0.92-1.32% annually. Table 2 outlines the incidence details in six-month time intervals. The incidence of awake intubation did not change significantly over this time period (slope -1.4^{-4} incidence-year⁻¹; 95% CI: -3.0^{-4} to 3.0^{-5} ; *P* = 0.102).

Table 1 Details of surgical procedures of 1,554 patients undergoing awake tracheal intubation

Procedure	(<i>n</i> =1,554)	Percent
Otorhinolaryngology	311	20%
Spine: cervical	235	15%
General surgery	228	15%
Orthopedics (non-spine)	183	12%
Thoracic	103	7%
Urology/gynecology	97	6%
Oral-maxillofacial	93	6%
Spine: thoracic/lumbar	74	5%
Cardiac/vascular	67	4%
Plastic surgery	66	4%
Inflammatory head and neck (operative or non-operative)	55	3%
Neurosurgery (intracranial)	42	3%

Table 2 Incidence and success rates of awake tracheal intubation

6-month intervals	2002 Jan-Jun	2002 Jul-Dec	2003 Jan-Jun	2003 Jul-Dec	2004 Jan-Jun	2004 Jul-Dec	2005 Jan-Jun	2005 Jul-Dec	2006 Jan-Jun	2006 Jul-Dec	2007 Jan-Jun	2007 Jul-Dec	2008 Jan-Jun
Awake intubations	55	60	70	42	67	59	81	65	63	54	64	66	83
Total intubated GA cases	5,168	5,286	5,611	5,223	6,134	5,222	5,584	5,477	5,372	5,130	6,101	6,375	7,190
6-month intervals	2008 Jul-Dec	2009 Jan-Jun	2009 Jul-Dec	2010 Jan-Jun	2010 Jul-Dec	2011 Jan-Jun	2011 Jul-Dec	2012 Jan-Jun	2012 Jul-Dec	2013 Jan-Jun	2013 Jul-Dec	Totals	
Awake intubations	63	68	79	60	67	68	69	56	71	59	65	1,554	
Total intubated GA cases	6,815	7,027	7,162	6,666	6,186	6,209	5,898	6,672	6,203	7,111	6,430	146,252	
Annual intervals	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Totals
Awake intubation rate, %	1.10	1.03	1.11	1.32	1.11	1.04	1.04	1.04	0.99	1.13	0.99	0.92	1.06
Failures	2	3	2	3	4	3	3	3	1	2	1	4	31
Overall success rate	98.3	97.3	98.4	97.9	96.6	97.7	97.9	98.0	99.2	98.5	99.2	96.8	98.0
First attempt success rate	93.8	95.4	96.8	95.8	93.8	98.4	95.8	93.8	90.5	91.9	91.3	89.2	93.9

GA = general anesthesia; Jan = January; Jun = June; Jul = July; Dec = December

Attempted awake intubation failed in 31 (2%) of the 1,554 cases. The causes of failure and subsequent disposition of these cases appear in Fig. 1. The one case involving complete loss of airway patency (“can’t intubate, can’t ventilate”) occurred during application of topical airway anesthesia in a patient with a submandibular abscess. In this case, an emergency surgical airway was successfully performed. No cases were cancelled or deferred following failed awake intubation.

A flexible bronchoscope was used to facilitate all but 12 of the 1,554 awake intubations (99.2%) in this series. For the GETA cases intubated after induction, reported uses of VL and other alternatives to DL for the study period appear in Table 3 and are presented graphically in Fig. 2. There was a significant increase in the use of VL over the 12 years (slope 0.080 incidence-year⁻¹; 95% CI: 0.076 to 0.086; $P < 0.001$), most pronounced from 2009 onwards.

In the convenience sample (2011–2013) that assessed how often each of 49 individual anesthesiologists performed awake tracheal intubation, the median [IQR] rate of awake intubation was 0.8 [0.4–1.3] per 100 patients undergoing GETA and varied from a low of zero to a high of 3.4 per 100 patients undergoing GETA (Fig. 3). As our hospital is a teaching institution, the attending anesthesiologists in this analysis may have performed the awake intubation themselves or they may have acted in a supervisory role for a resident. The attending anesthesiologists’ median [IQR] years of experience at the institution was 10.1 [6.1–17.1] yr.

Complications during successful awake intubation were self-reported in 239 (15.7%) of the 1,554 cases (Table 4).

Discussion

There was no significant change in the incidence of awake tracheal intubation from 2002–2013 despite a significant increase in the use of VL for tracheal intubation after induction of general anesthesia, most prevalent from approximately 2009 onwards.

The relatively unchanged incidence of awake tracheal intubation may relate to the many alternatives to direct laryngoscopy (e.g., the Trachlight, LMA-Fastrach, Bullard laryngoscope, and flexible bronchoscope) that were widely available predating the introduction of VL. Thus, while an effective airway adjunct,⁹ the video laryngoscope may not have significantly impacted how often awake tracheal intubation is performed. Moreover, the decision to perform awake intubation also incorporates factors such as anticipated difficult bag and mask ventilation, a full stomach, predicted intolerance of apnea, or a lack of expert help.¹ None these latter factors would be affected by VL, which might further explain the steady incidence of awake intubation over time. Even if the need for awake intubation had been diminished by more frequent use of VL, it is also conceivable that such a decrease could have been masked by a concomitant rise in awake intubation for an increasing population of obese patients¹⁰ in whom a higher incidence of anticipated difficult airway management might be expected.^{11–20}

While the overall incidence of awake tracheal intubation was 1.06% of GETA cases, there was substantial variability in the rate (0–3.4 per 100 GETA cases) at which individual attending staff performed the procedure. These results were not controlled for subspecialty practice (e.g.,

Fig. 1 Results and disposition of successful and failed attempted awake tracheal intubation. IV = intravenous; GA = general anesthesia; trach = tracheostomy

Table 3 All use of alternatives to direct laryngoscopy for tracheal intubation of 146,252 patients undergoing general anesthesia, 2002-2013 - Excludes use of flexible bronchoscopy

6-month intervals	2002		2003		2004		2005		2006		2007	
	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec
Total intubated GA cases	5,168	5,286	5,611	5,223	6,134	5,222	5,584	5,477	5,372	5,130	6,101	6,375
GlideScope	7	4	15	10	43	51	89	51	56	160	200	179
Storz C-MAC (Mac and D blades)	0	0	0	0	0	0	0	0	0	0	0	0
Other VL	0	0	0	0	0	0	0	0	0	0	0	4
All VL (% of intubated cases)	7 (0.1)	4 (0.1)	15 (0.3)	10 (0.2)	43 (0.7)	51 (1.0)	89 (1.6)	51 (0.9)	56 (1.0)	160 (3.1)	200 (3.3)	183 (2.9)
Lighted stylet (e.g., Trachlight)	260	311	356	321	372	303	292	247	213	251	300	285
Viewing stylets (e.g., Shikani, Levitan)	12	9	5	5	6	11	4	0	0	21	26	11
Bullard laryngoscope	39	20	66	25	49	68	36	59	33	26	29	15
LMA-Fastrach	11	31	25	9	14	12	13	5	11	25	17	14
All alternatives to DL excluding VL (% of total intubated cases)	322 (6.2)	371 (7.0)	452 (8.1)	360 (6.9)	441 (7.2)	394 (7.5)	345 (6.2)	311 (5.7)	257 (4.8)	323 (6.3)	372 (6.1)	325 (5.1)
All alternatives to DL including VL (% of total intubated cases)	329 (6.4)	375 (7.1)	467 (8.3)	370 (7.1)	484 (7.9)	445 (8.5)	434 (7.8)	362 (6.6)	313 (5.8)	483 (9.4)	572 (9.4)	508 (8.0)
6-month intervals	2008		2009		2010		2011		2012		2013	
	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec
Total intubated GA cases	7,190	6,815	7,027	7,162	6,666	6,186	6,209	5,898	6,672	6,203	7,111	6,430
GlideScope	183	201	199	183	134	256	231	265	259	266	240	233
Storz C-MAC (Mac and D blades)	0	0	3	0	0	46	208	213	236	264	363	453
Other VL	9	48	28	82	74	51	30	44	39	15	47	26
All VL (% of intubated cases)	192 (2.7)	249 (3.7)	230 (3.3)	265 (3.7)	208 (3.1)	353 (5.7)	469 (7.6)	522 (8.9)	534 (8.0)	545 (8.8)	650 (9.1)	712 (11.1)
Lighted stylet (e.g., Trachlight)	248	213	269	191	158	135	183	140	169	95	87	91
Viewing stylets (e.g., Shikani, Levitan)	11	6	16	14	16	32	19	8	9	7	19	12
Bullard laryngoscope	7	10	5	10	4	11	10	2	2	1	6	0
LMA-Fastrach	13	8	17	14	9	30	17	1	15	10	12	14
All alternatives to DL excluding VL (% of total intubated cases)	279 (3.9)	237 (3.5)	307 (4.4)	229 (3.2)	187 (2.8)	208 (3.4)	229 (3.7)	151 (2.6)	195 (2.9)	113 (1.8)	124 (1.7)	117 (1.8)
All alternatives to DL including VL (% of total intubated cases)	471 (6.6)	486 (7.1)	537 (7.6)	494 (6.9)	395 (5.9)	561 (9.1)	698 (11.2)	673 (11.4)	729 (10.9)	658 (10.6)	774 (10.9)	829 (12.9)

GA = general anesthesia; VL = video laryngoscopy; DL = direct laryngoscopy; LMA = Laryngeal Mask Airway; Jan = January; Jun = June; Jul = July; Dec = December

Fig. 2 Use of alternatives to direct laryngoscopy after induction of general anesthesia from 2002-2013. DL = direct laryngoscopy; VL = video laryngoscopy; LW = lighted stylet; ILMA = LMA-Fastrach; BL = Bullard laryngoscope; VS = viewing stylet

Fig. 3 Graphic representation of the rate of awake intubation per 100 general anesthesia cases requiring tracheal intubation for each of 49 attending staff anesthesiologists over three years

Table 4 Complications encountered during ultimately successful awake tracheal intubation

Complication	Number (<i>n</i> = 239)	Percent
> 1 attempt, cause not specified	64	26.8%
Cough or gag during intubation	54	22.6%
Hang-up on larynx caused difficulty with tube passage but no change in tube size or type undertaken	42	17.6%
Required change to smaller or Parker tube	29	12.1%
Blood or secretions caused difficulty	16	6.7%
Airway compromise occurred with application of local anesthetic	12	5.0%
Patient uncooperative	7	2.9%
Cuff leak apparent after intubation	5	2.1%
Change of route required (nasal to oral or vice versa)	5	2.1%
Patient excessively sedated	4	1.7%
Inadvertent immediate extubation	1	0.4%

anesthesiologists performing mainly regional vs neuroanesthesia), although anecdotally, the four individuals with the two lowest and the two highest rates of awake intubation had similar practice profiles (data not shown). This suggests at least some variability among staff in their personal thresholds for performing awake tracheal intubation.

Our findings are consistent with some of those reported recently in a study by Wanderer *et al.*⁷ In their large ($n = 317,509$) database review of cases conducted under general anesthesia using either an ETT or SGD during March 2001 to February 2013, a significant increase in the use of VL was reported beginning around 2008. A continuous decline in the use of the flexible bronchoscope was apparent during their study period, although no statistical analysis was reported for their observation. In addition, the report made no distinction between use of the device for awake tracheal intubation or for intubation after the induction of general anesthesia.

As our institution is a typical Canadian tertiary care centre with most types of surgery represented, we have no reason to suspect that the rate of awake intubation was any different from that at similar institutions. Nonetheless, we acknowledge that institutional preferences exist for certain practices or procedures. On that basis, even with comparable surgical populations, our incidence of awake tracheal intubation could differ from that occurring in other tertiary care hospitals. Our use of non-VL alternatives to DL (e.g., lighted stylet, LMA-Fastrach, Bullard laryngoscope, and visual stylets) decreased over the examined time period. We could not identify published literature with which to compare this finding. Although decreasing, lighted stylet use was significant at our institution throughout the time period.

An awake tracheal intubation was performed on more males than females by a ratio of 2:1. This finding corresponds with those in previous large-scale studies, i.e., males experience a higher incidence of difficult face mask ventilation and/or tracheal intubation than females.²¹⁻²⁴ It is also not unexpected that otolaryngology and cervical spine procedures were the most highly represented for awake intubation. That general surgery occurred next most commonly might be explained in some instances by full stomach concerns coinciding with predictors of difficult tracheal intubation.

The 2% failure rate of attempted awake intubation was comparable with rates of 1.2–1.8% published previously in the context of clinical trials.^{25,26} Sixty-five percent of awake intubation failures and 52% of recorded complications in this study related to either difficulty with ETT passage through the larynx or suboptimal topical airway anesthesia. Both of these complications could potentially be prevented, e.g., with the primary use of a

smaller or Parker ETT (Parker Medical, Englewood, CO, USA)²⁷ over an adult-sized bronchoscope or with more effective application of topical airway anesthesia, respectively. It is also worth mentioning that 5% of the self-reported complications related to partial or complete compromise of airway patency simply with application of topical airway anesthesia. This has been previously described²⁸⁻³³ but is an underappreciated phenomenon that underscores the need for an alternative plan even with the alleged safety margin provided by awake intubation.

Published guidelines continue to recommend awake intubation as an option for the patient with anticipated difficult airway management.^{1,2} Knowledge of the incidence of awake tracheal intubation may help provide benchmark data for residency programs and continuing education officers in designing airway education curriculum.

There were some limitations to our study. Although we have no reason to think that our surgical case mix or patient population differs significantly from other tertiary care centres (i.e., our results should be generalizable to other similar centres), they may not be applicable to non-teaching or community-type practices. Furthermore, the findings may not necessarily be applicable to out-of-operating room environments such as emergency departments or critical care units. As a retrospective study, some results may have been prone to imprecision and underreporting, especially self-reported factors such as the need for multiple or prolonged attempts at awake tracheal intubation or other complications encountered during the procedure.

In conclusion, during 2002–2013 at our tertiary care institution, 1.06% of patients undergoing general anesthesia with tracheal intubation underwent awake intubation. No significant change in the incidence of awake tracheal intubation was observed over the study time period. Awake tracheal intubation appears to have a high success rate. Variability in the use of awake intubation among staff could have implications for quality assurance surveillance and continuing professional development programs. In spite of the increasing use of VL, it appears that awake tracheal intubation retains an important and consistent role in the management of the difficult airway.

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Conflicts of interest None declared.

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