Changes in practice in managing difficult intubation following the introduction of new airway devices

V. Guarnero, I. Bathory, C. Perruchoud, P. Frascarolo, P. Schoettker

Department of Anesthesiology, Rue du Bugnon, CH 1011 Lausanne CHUV

Introduction

Difficult or failed tracheal intubation is a leading cause of anesthesia-related mortality and morbidity, ranging from soft tissue airway trauma to severe hypoxemia [1-3].

Direct laryngoscopy with the curved laryngoscope blade designed by Macintosh in 1943 [4] still represents the gold standard to perform endotracheal intubation. Strategies and guidelines for the management of predicted and unpredicted difficult airways have been published by the Difficult Airway Society of the UK [5-7], as by many other national societies. They incorporate essentially external airway maneuvers and patient positioning, direct laryngoscopy and stylets, extraglottic devices, fiberoptic bronchoscopy, as well as surgical techniques.

Following the significant progresses in fiberoptic and video technologies, a wide variety of intubation devices have been developed recently and transposed into clinical practice. This may lead to changes in management with regard to the difficult airways. Studies are on their way [8], but the place of these new airway devices in clinical practice must be further assessed.

Recognizing a difficult airway remains a challenge and the absence of any single sensitive predictive factor may lead to unexpected dangerous situations [9]. Difficult intubation ranges between 0.1% to 10.1%, depending on the definition [10], and rates as high as 8-30% have been reported in neurosurgical or ENT (ear, nose and throat) patients [11, 12]. Indeed, in patients with cervical spine injury, securing the airway while correctly immobilizing the cervical spine to avoid secondary neurological damage may be challenging. ENT disease, previous surgery, radiotherapy

and chemotherapy, may lead to airway narrowing or distortion at laryngeal, sub-glottic or tracheal level.

The aim of this study was to compare the management of difficult intubation before and after the introduction of the Airtraq® and the Glidescope® in our institution for patients undergoing neurosurgical or ENT procedures necessitating tracheal intubation. We also analyzed the criteria used by anesthesiologists in our teaching hospital to predict difficult intubation in the same population.

Methods

For this retrospective study we analyzed the medical files of all adult patients (18 years and older) who had general anesthesia for neurosurgical or ENT procedures from March 2005 to March 2009 in the University Hospital of Lausanne, Switzerland. For each anesthesia, patient characteristics, epidemiologic data and preoperative airway assessment (mouth opening (MO), Mallampati class (MP), Thyromental distance (TMD), neck mobility) as well as previous airway management data were collected. Patients were included if difficult intubation was suspected during the preoperative anaesthetic evaluation, based on the presence of at least one of the following criteria: MO<5cm, MP III or IV, TMD<7cm, reduced neck mobility, history of difficult intubation, or if difficult intubation was described on a previous anaesthesiologic chart (coded difficult intubation, intubation which required another device than the one planned initially, Cormack and Lehane grade 3 and 4). Patients with a tracheotomy were excluded.

We defined three time periods: period A (March 2005-February 2007), period B (March 2007-May 2008) and period C (June 2008-March 2009). The Airtraq® was introduced in our hospital in March 2007 and the Glidescope® in June 2008.

Statistical tests used were median or chi-square when appropriate. Data were analyzed using the JMP 6 statistical package (SAS Institue Inc. Cary, NC, USA).

Results

Between March 2005 and March 2009, 5896 patients necessitated a general anaesthesia for a neurosurgical or ENT procedure. According to our criteria, 1190 patients were included. Patients' characteristics and anthropometric data in relation with failure and success of intubations are summarised in table 1.They are similar between the three periods except for history of oral surgery, which is significantly more frequent during the period A.

The Macintosh laryngoscope was the most frequently used tool for tracheal intubation (Table 2). The incidence of fiberoptic intubation decreased from 25% (period A), to less than 5% (period C). Spontaneous breathing sevoflurane induction diminished by half between the periods with an almost disappearance of the awake intubation technique during the period C. The utilisation of the new airway devices increased from zero to more than a third of the intubations.

Among all included patients, difficult intubation was documented in 511 patients (8.7%).

Preoperative airway assessment was significantly more often performed in period C as shown in table 3. Difficult intubation criteria are equally present during the three periods. The assessment and documentation of the mouth opening and Mallampati score were most frequently performed among the pre-operative predictive difficult intubation criteria. A third of the patients in each period were identified with a Mallampati III or IV.

Discussion

The recent introduction of new videolaryngoscopes for airway management has led to visible changes in practice in our institution.

In case of predicted or suspected difficult airways, before Airtraq® and Glidescope® introduction, a combination of different techniques were used, such as macintosh laryngoscopy in 75% of cases, fiberoptic bronchoscopy in 24.7%, stylets in 11.1%, awake intubation in 9.6% and sevoflurane induction in 13%. After their introduction, Macintosh laryngoscopy, fiberoptic bronchoscopy, stylets, McCoy, awake intubation and sevoflurane induction became less popular, and progressively replaced by the Aitraq® and the Glidescope® in respectively 14.4% and 22% of the cases. The laryngeal mask, which is included in difficult airway algorithms [13, 14], is poorly used in our hospital.

Fiberoptic bronchoscopy, associated or not with an awake intubation technique, has been the "gold standard" for the management of anticipated difficult airways [15]. The place the new airway devices occupy in difficult airway, including the Airtraq® and the Glidescope®, needs to be clarified. Several studies have already shown their value in different situations such as: cervical spine immobilization [16, 17], failed direct laryngoscopy [18], intubation by untrained medical personnel [19, 20] or anticipated difficult airways [21, 22]. They also require less operator skills to intubate at the first attempt [19, 23], due to their rapid learning curve [24]. However, none of these videolaryngoscopes are yet included in a national society difficult airway management algorithm.

Moreover, the growing number and use of alternative airway devices and the reduction in working hours lead to a diminishing skill base amongst trainees [25-27].

It is established that preoperative detection of patients at risk of difficult intubation is the first step in the management of airways. A lot of predictive criteria have been identified, with some validated risk index or scores [28-31]. Shiga and colleagues [3] reported in a meta-analysis of bedside screening tests usually performed to predict difficult intubation, that each of them used alone has a poor to moderate discriminative power. Combinations of them increase the diagnostic value in comparison with the value of each test alone. They found that the best combination was Mallampati classification and thyromental distance (positive likelihood ratio: 9.9). In the second part of our study, we observe the preoperative assessment folder of our patients. It comes out that they are many missing data. The two predictive factors that are poorly assessed are the neck mobility and the thyromental distance (96% and 72% missing value in period A), although Shiga and colleagues showed this last associated to MP is strong. We can see that these values got better in the period C, maybe because the doctors were a lot sensitized about this point.

If we focus only on the difficult intubation and the presence or not of predictive factors, we can notice that only 19.4% of the patients had a history of ID, 40.9% a decreased MO, 4.3% a TMD, 19.2% a MP class III, 5.3% a MP class IV and 25.8% reduced neck mobility. Moreover, 29.2% of the difficult intubation didn't have any single predictive factor. This show one more time that this entire screening test haven't a high discriminative power, especially when they are not all assessed.

If we want to be more sensitive about the difficult airway, it implies a better preoperative airway assessment. Our study highlighted an incidence of difficult intubation of 8.7% in neuro and ENT patients.

In conclusion, the Airtraq® ans the Glidescope® offer new approaches for the management of normal and difficult airway. Further randomized controlled studies are necessary to establish the

role that each of the newly airway device may play in the management of difficult airway. Their more frequent usage must question their place in the difficult airways guidelines.

Table 1. Patients characteristics

Patients characteristics

	Period A	Period B	Period C	P Values (A vs C)
Age (years)	56.3±16.9	53.9 ±18	55.6±16.9	0.560
Male/Female	332/191	227/127	190/122	0.316
Weight (kg)	71.8±15.4	72.7±17.3	71.5±16.8	0.816
BMI ($kg.m^{-2}$)	25.0±4.6	25.4±5.2	25.0±5.0	0.923
Hypertension	178	106	106	1.000
Diabetes	47	32	21	0.296
SAOS	23	23	22	0.114
Obesity	71	53	37	0.523
Radiotherapy	53	47	43	0.118
Chemotherapy	25	21	23	0.127
History of oral surgery	39	16	11	0.023
History of extra oral surgery	12	12	12	0.205
History of combined oral and extra oral surgery	6	5	6	0.381
History of cervical spine surgery	5	3	0	0.164

Table 2. Airway management

	A(523)		B(354)		C(313)		A. Vs. C
Tools	N	%	N	%	N	%	p
Laryngoscope	392	75.0	231	65.3	176	56.2	<0.001
McCoy	14	2.7	11	3.1	1	0.3	0.013
Bougie	58	11.1	40	11.3	22	7.0	0.068
First generation video laryngoscope	4	0.8	23	6.5	6	1.9	0.188
Airtraq	0	-	49	13.8	45	14.4	<0.001
Glidescope	0	-	9	2.5	69	22.0	<0.001
Fibrescope	129	24.7	38	10.7	14	4.5	<0.001
Intubating laryngeal mask	0	-	13	3.7	3	1.0	0.052
Laryngeal mask	1	0.2	1	0.3	0	-	1.000
Sevofluran inhalation	68	13.0	30	8.5	18	5.6	<0.001
Awake intubation	50	9.6	6	1.7	2	0.6	<0.001

Table 3. Airway assessment

		Période						
		A(523)		B(354)		C(313)		A vs C
		N	%	N	%	N	%	P value
ATCD ID	yes	61	11.7	38	10.7	30	9.6	0.413
	no	462	88.3	316	89.3	283	90.4	
OB	>5cm	195	37.3	136	38.4	120	38.3	0.818
	<5cm	241	46.1	164	46.3	136	43.5	0.504
	Missing Value	87	16.6	54	15.3	57	18.2	0.625
DTM	>7cm	6	1.1	21	5.9	19	6.1	<0.001
	<7cm	14	2.7	29	8.2	35	11.2	<0.001
	Missing Value	503	96.2	304	85.9	259	82.3	<0.001
Mallampati	MP I	111	21.3	78	22	60	19.2	0.533
	MP II	160	30.6	97	27.4	98	31.3	0.889
	MP III	133	25.4	98	27.7	85	27.2	0.639
	MP IV	32	6.1	13	3.7	11	3.5	0.137
	Missing Value	87	16.6	68	19.2	59	18.8	0.470
Neck Mobility	Normal	41	7.8	45	12.7	18	5.8	0.313
	Reduced	105	20.1	101	28.5	99	31.6	<0.001
	Missing Value	377	72.1	208	58.8	196	62.6	0.006

References

1. Caplan, R.A., et al., *Adverse respiratory events in anesthesia: a closed claims analysis.* Anesthesiology, 1990. **72**(5): p. 828-33.
2. Crosby, E.T., et al., *The unanticipated difficult airway with recommendations for management.* Canadian journal of anaesthesia = Journal canadien d'anesthesie, 1998. **45**(8): p. 757-76.
3. Shiga, T., et al., *Predicting difficult intubation in apparently normal patients: a meta-analysis of bedside screening test performance.* Anesthesiology, 2005. **103**(2): p. 429-37.
4. Macintosh, R.R., *Technique of laryngeal anaesthesia.* Lancet, 1947. **2**(6463): p. 54.
5. *Practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway.* Anesthesiology, 2003. **98**(5): p. 1269-77.
6. Langeron, O., et al., *[Difficult airway algorithms and management: question 5. Societe Francaise d'Anesthesie et de Reanimation]*. Ann Fr Anesth Reanim, 2008. **27**(1): p. 41-5.
7. Frova, G., et al., *Recommendations for airway control and difficult airway management in paediatric patients.* Minerva Anestesiol, 2006. **72**(9): p. 723-48.
8. Amathieu, R., et al., *An algorithm for difficult airway management, modified for modern optical devices (Airtraq laryngoscope; LMA CTrach): a 2-year prospective validation in patients for elective abdominal, gynecologic, and thyroid surgery.* Anesthesiology, 2011. **114**(1): p. 25-33.
9. Tse, J.C., E.B. Rimm, and A. Hussain, *Predicting difficult endotracheal intubation in surgical patients scheduled for general anesthesia: a prospective blind study.* Anesth Analg, 1995. **81**(2): p. 254-8.
10. Rose, D.K. and M.M. Cohen, *The incidence of airway problems depends on the definition used.* Can J Anaesth, 1996. **43**(1): p. 30-4.
11. Ayuso, M.A., et al., *Predicting difficult orotracheal intubation in pharyngo-laryngeal disease: preliminary results of a composite index.* Can J Anaesth, 2003. **50**(1): p. 81-5.
12. Calder, I., J. Calder, and H.A. Crockard, *Difficult direct laryngoscopy in patients with cervical spine disease.* Anaesthesia, 1995. **50**(9): p. 756-63.
13. Langeron, O., et al., *Clinical review: management of difficult airways.* Crit Care, 2006. **10**(6): p. 243.
14. Benumof, J.L., *Laryngeal mask airway and the ASA difficult airway algorithm.* Anesthesiology, 1996. **84**(3): p. 686-99.
15. Ezri, T., et al., *Difficult airway management practice patterns among anesthesiologists practicing in the United States: have we made any progress?* J Clin Anesth, 2003. **15**(6): p. 418-22.
16. Bathory, I., et al., *Evaluation of the GlideScope for tracheal intubation in patients with cervical spine immobilisation by a semi-rigid collar.* Anaesthesia, 2009. **64**(12): p. 1337-41.
17. Maharaj, C.H., et al., *Endotracheal intubation in patients with cervical spine immobilization: a comparison of macintosh and airtraq laryngoscopes.* Anesthesiology, 2007. **107**(1): p. 53-9.
18. Aziz, M.F., et al., *Routine clinical practice effectiveness of the Glidescope in difficult airway management: an analysis of 2,004 Glidescope intubations, complications, and failures from two institutions.* Anesthesiology, 2011. **114**(1): p. 34-41.

19. Maharaj, C.H., et al., *Learning and performance of tracheal intubation by novice personnel: a comparison of the Airtraq and Macintosh laryngoscope.* Anaesthesia, 2006. **61**(7): p. 671-7.
20. Nouruzi-Sedeh, P., M. Schumann, and H. Groeben, *Laryngoscopy via Macintosh blade versus GlideScope: success rate and time for endotracheal intubation in untrained medical personnel.* Anesthesiology, 2009. **110**(1): p. 32-7.
21. Savoldelli, G.L., et al., *Use of the Airtraq as the primary technique to manage anticipated difficult airway: a report of three cases.* J Clin Anesth, 2008. **20**(6): p. 474-7.
22. Cooper, R.M., et al., *Early clinical experience with a new videolaryngoscope (GlideScope) in 728 patients.* Can J Anaesth, 2005. **52**(2): p. 191-8.
23. Mulcaster, J.T., et al., *Laryngoscopic intubation: learning and performance.* Anesthesiology, 2003. **98**(1): p. 23-7.
24. Maharaj, C.H., et al., *Evaluation of intubation using the Airtraq or Macintosh laryngoscope by anaesthetists in easy and simulated difficult laryngoscopy--a manikin study.* Anaesthesia, 2006. **61**(5): p. 469-77.
25. Smith, N.A., A. Tandel, and R.W. Morris, *Changing patterns in endotracheal intubation for anaesthesia trainees: a retrospective analysis of 80,000 cases over 10 years.* Anaesthesia and intensive care, 2011. **39**(4): p. 585-9.
26. Weller, J. and R. Segal, *The acquisition of airway skills by new trainee anaesthetists.* Anaesthesia and intensive care, 2008. **36**(4): p. 487-8.
27. Smith, N. and A. Koutantos, *Airway experience of anaesthetic registrars.* Anaesthesia and intensive care, 2008. **36**(4): p. 516-9.
28. Wilson, M.E., et al., *Predicting difficult intubation.* Br J Anaesth, 1988. **61**(2): p. 211-6.
29. Arne, J., et al., *Preoperative assessment for difficult intubation in general and ENT surgery: predictive value of a clinical multivariate risk index.* Br J Anaesth, 1998. **80**(2): p. 140-6.
30. el-Ganzouri, A.R., et al., *Preoperative airway assessment: predictive value of a multivariate risk index.* Anesth Analg, 1996. **82**(6): p. 1197-204.
31. Karkouti, K., et al., *Inter-observer reliability of ten tests used for predicting difficult tracheal intubation.* Can J Anaesth, 1996. **43**(6): p. 554-9.