

The incidence of airway problems depends on the definition used

D. Keith Rose MD FRCPC,*
Marsha M. Cohen MD FRCPC†‡

Purpose: Definitions currently used to describe airway difficulties are confusing, inconsistent, and may be misleading. To understand the "extent of the problem" better using three different definitions we examined the corresponding rates of airway difficulty in 3,325 consecutive adult patients who had direct laryngoscopy with tracheal intubation following induction of general anaesthesia.

Methods: Definitions were (i) poor view at laryngoscopy (GRADE 3–4) documented on modified diagrams of Cormack and Lehane; (ii) ≥ 3 laryngoscopy attempts; and (iii) failure of direct laryngoscopy. The incidences of airway difficulty attributable to each definition were compared.

Results: For the three definitions rates varied, 10.1% for poor view, 1.9% ≥ 3 laryngoscopies, and failure 0.1%. For patients with a GRADE 3–4 view, 15.8% required ≥ 3 laryngoscopies, but for those with ≥ 3 laryngoscopies, 84.1% had GRADE 3–4 view. All patients with failed laryngoscopy had ≥ 3 laryngoscopies and a GRADE 4 view.

Conclusion: This wide variation in defining the "extent of the

problem" emphasizes the need for agreement of definitions and improved methods to document airway difficulties.

Objectif: Les définitions en usage actuellement pour caractériser les problèmes rencontrés au niveau des voies aériennes créent de la confusion, sont inconstantes et souvent trompeuses. Pour mieux comprendre l'importance du problème, nous avons étudié, à l'aide de trois définitions, la proportion correspondante de difficultés au niveau des voies respiratoires de 3325 adultes consécutifs qui subissaient une laryngoscopie directe avec intubation de la trachée sous anesthésie générale.

Méthodes: Les définitions choisies étaient: i) la visualisation médiocre à la laryngoscopie (grades 3 et 4) documentée sur des diagrammes modifiés de Cormack et Lehane; ii) trois tentatives de laryngoscopie ou plus; et iii) l'échec de la laryngoscopie directe. L'incidence des difficultés causées par les voies aériennes correspondant à chacune de ces définitions a été comparée.

Résultats: Les taux ont varié selon la définition; 10,1% pour la visualisation médiocre, 1,9% pour trois laryngoscopies et plus, et 0,1 pour l'échec de la laryngoscopie. Des patients dont la visualisation était de grade 3–4, 15,8% ont eu besoin d'au moins trois laryngoscopies mais pour ceux qui ont eu besoin d'au moins trois laryngoscopie, 84,1% avaient une visualisation de grade 3–4. Dans tous les cas d'échec, on a réalisé trois laryngoscopies et plus et la visualisation était de grade 4.

Conclusion: La grande variabilité des définitions souligne le besoin d'une concertation sur les définitions et de l'amélioration des méthodes qui servent à documenter les problèmes qu'on rencontre au niveau des voies aériennes.

Key words

AIRWAY: assessment, management;
COMPLICATIONS: intubation, tracheal;
LARYNX: laryngoscopy.

From the Department of Anaesthesia, St. Michael's Hospital and the Department of Anaesthesia, University of Toronto, Toronto, Canada*. Clinical Epidemiology Unit, Sunnybrook Health Science Centre, and the Institute for Clinical Evaluative Sciences, Toronto, Canada†. Department of Health Administration, University of Toronto, Toronto, Canada; Department of Anaesthesia, Sunnybrook Health Science Centre, and the University of Toronto, Toronto, Canada‡.

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Address correspondence to: Dr. Keith Rose, Department of Anaesthesia, St. Michael's Hospital, 30 Bond Street, Toronto, Ontario M5B 1W8.

Phone: (416) 864-071. Fax: (416) 864-6014.

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Anaesthetists agree that the "difficult airway" is a serious problem. What is not agreed upon, however, is what is meant by a "difficult airway." The definitions used for airway problems encountered by anaesthetists are inconsistent and are potentially misleading. The documentation of difficulties which occur at the time of tracheal intubation vary, not only among anaesthetists but also between hospitals.

Recent studies also differ in their definition of a difficult airway. Current definitions include failure to intu-

bate, three or more laryngoscopies, four or more attempts to pass the endotracheal tube or longer than ten minutes, or a poor view of the vocal cords on direct laryngoscopy following induction of anaesthesia.¹⁻⁴ As expected, depending on the definition used, the incidence of airway problems as well as the risk factors associated with the specific airway problem, will be extremely variable.

There have not been any studies which have examined the variability of the incidence of airway difficulty using different definitions, and the impact on the resulting rates of airway difficulties associated with each definition. In this paper, we compare the rate of airway difficulty found if three different commonly-used definitions are used. The patient population in the study comprised a large series of consecutive adult patients who were managed with general anaesthesia followed by direct laryngoscopy for tracheal intubation.

Methods

After St. Michael's Hospital Research Ethics Board approval for this study, we examined the issue of airway management and difficulties at the time of tracheal intubation in all nonobstetrical patients ($n = 3,325$) who had a direct laryngoscopy and insertion of endotracheal tube following induction of general anaesthesia and paralysis. Twenty-five certified anaesthetists in a tertiary-care teaching hospital participated in the study over a seven-month period (September 1993 to March 1994). Cases where tracheal intubation was anticipated to be difficult such that an alternative method was chosen as the primary approach for tracheal intubation were not included. Patients with missing documentation were also excluded ($n = 444$).

On a revised anaesthetic record, each anaesthetist recorded the outcome of tracheal intubation in three different ways: (1) poor view at laryngoscopy (GRADE 3-4) using the modified diagrams of Cormack and Lehane (Figure 1);⁵ (2) three or more direct laryngoscopy attempts before insertion of the endotracheal tube; and (3) failure to insert the endotracheal tube with direct laryngoscopy. Records had been revised accordingly to include the four modified diagrams of the larynx by Cormack and Lehane, the number of laryngoscopy attempts, a tic box for cases requiring three or more laryngoscopy attempts, and a space to document alternative methods required for endotracheal intubation.

Upon the introduction of the new anaesthetic records, anaesthetists were instructed on the interpretation of the definitions used for airway difficulties. This included how to grade the view at laryngoscopy using the diagrams displayed on the record: GRADE 1 – visualization of the entire laryngeal aperture; GRADE 2 – visual-

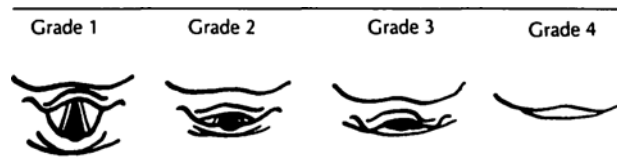


FIGURE 1 The modified diagrams of Cormack and Lehane used to document view at laryngoscopy.

ization of the posterior portion of the laryngeal aperture; GRADE 3 – visualization of the epiglottis only; and GRADE 4 – visualization of the soft palate and not the epiglottis⁵ (Figure 1). In this study, a GRADE 3 or 4 view at laryngoscopy was used to indicate a poor view.

The number of laryngoscopy attempts was defined as the number of times the laryngoscope was inserted in the mouth after induction of general anaesthesia before successful tracheal intubation. If three or more attempts were required, a separate tic box was used to indicate that difficult tracheal intubation had occurred.⁶ Failure was documented when either an alternative approach was required (e.g., fiberoptic visualization), or all approaches were unsuccessful and the surgical procedure cancelled. Carbon copies of all anaesthetic records were subsequently reviewed by a trained anaesthetic research nurse and an anaesthetist before data entry in an anaesthesia database.⁷

The rates of airway difficulty found using each definition were compared. The relationships between view at laryngoscopy, the number of laryngoscopy attempts, and failure were also examined.

Results

Characteristics of patients in the study population ($n = 3,325$) were 46.5% men, 26.6% ASA physical status 3-4, 38.4% <40 yr, 29.4% >60 yr, 1.2% of men >120 kg and 1.6% of women >110 kg, 0.8% rheumatoid arthritis, and 2.3% with some form of neuromuscular disease. Surgical procedures included spinal surgery 5.5%, major vascular 11.5%, eye, ear, nose, and throat 11.3%, and other head and neck 5.0%. Preoperative examination of four physical characteristics (mouth opening, neck movement, thyromental distance, and oropharyngeal view) suggested that 16.4% of patients might have had potential difficulty with airway management.

The view at laryngoscopy, number of laryngoscopies, and failures are seen in Figure 2. If the difficult airway was defined as poor (GRADE 3-4) view at laryngoscopy, the rate found was 10.1% ($n = 336$). Using the definition of three or more laryngoscopy attempts, the rate found was 1.9% ($n = 63$) and if four or more laryngoscopies were used, the rate of difficulty would be 0.5% ($n = 16$). There were no nasotracheal intubations

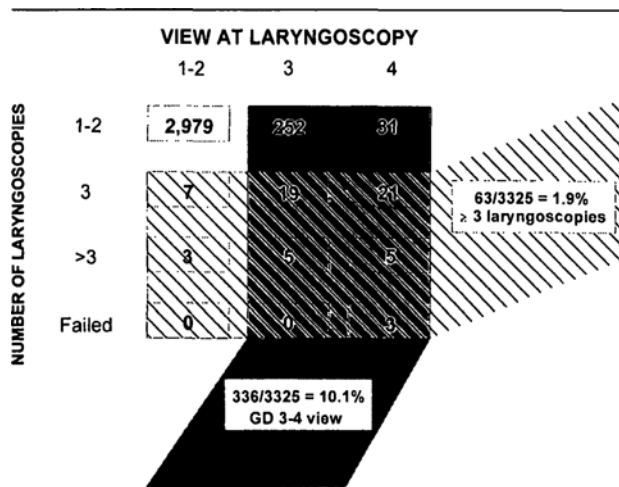


FIGURE 2 Frequencies of airway difficulty using the three definitions: view at laryngoscopy, number of laryngoscopies, and failure of direct laryngoscopy.

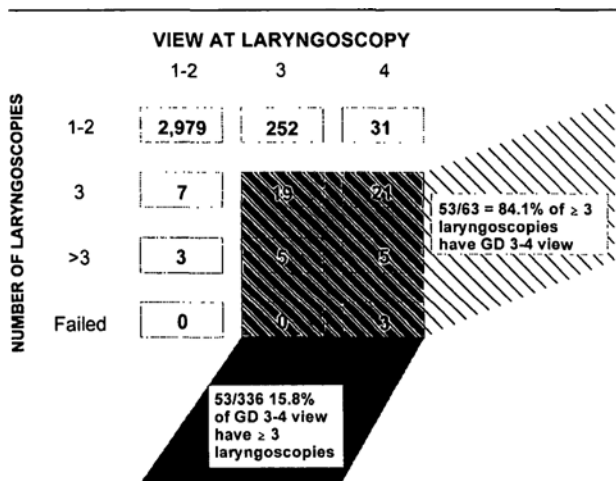


FIGURE 3 Relationship of view at laryngoscopy, number of laryngoscopies, and failure of direct laryngoscopy.

in those who required more than three laryngoscopies. Finally, if the difficult airway were defined as failed direct laryngoscopy, the rate would only be 0.1% ($n = 3$).

Using the three different definitions were the same patients identified? Among patients with a GRADE 3–4 view, only 53 of 336 (15.8%) required three or more laryngoscopies (Figure 3). Conversely, for those needing three or more laryngoscopy attempts, 53 of 63 (84.1%) had a GRADE 3–4 view. All three patients who experienced a failed direct laryngoscopy had a GRADE 4 view and had more than three laryngoscopy attempts. In these patients the tracheas were all successfully intubated by alternative methods.

Discussion

Examining 3,325 consecutive surgical patients who had a direct laryngoscopy after induction of general anaesthesia indicates that poor view at laryngoscopy (GRADE 3–4) is a relatively common finding (10.1%) even after excluding patients in whom difficult tracheal intubation was anticipated and an alternative technique was chosen. However, in this same population the need for more than three laryngoscopies occurs much less frequently (1.9%), and failed direct laryngoscopy is a rare event (0.1%). View at laryngoscopy and number of laryngoscopy attempts measured different dimensions. Only a small percentage of patients who had poor view during laryngoscopy actually required three or more laryngoscopies (15.8%), but most of those with more than three laryngoscopies had a poor view at laryngoscopy (84.1%). All failed laryngoscopies were in patients who exhibited a poor view at laryngoscopy and required three or more laryngoscopies.

Several studies have used the original Cormack and Lehane definition of poor view, that is, only epiglottis or no epiglottis seen. In their original paper, Cormack and Lehane expected that such a patient would be seen only once every two years for each anaesthetist's practice, a very different rate from that documented in this study (10.1%).⁴ Studies that have used this definition of airway difficulty (only epiglottis or no epiglottis seen) have documented different rates, from 11.3% to 1.1%.^{8–14}

Using a slightly different definition of poor view (only corniculate cartilages visualized or glottis not exposed), Mallampati identified 28 of 210 patients (13.3%) who had a difficult laryngeal exposure.¹⁵

Studies which have used the number of laryngoscopies to examine outcome or airway difficulties are fewer in number. Using this methodology to define the difficult airway, the rates found are less variable and similar to those found in the present study. Three large epidemiological studies noted frequencies of 2.1%, requiring two or more laryngoscopies, a stylet, different blade, or assistance from a senior colleague,¹² 1.8% with three or more laryngoscopies,⁶ and 1.2% difficult with two or more laryngoscopies by two individuals.*

As a definition, failure to intubate has been used less frequently and varies from 0.3% to 0.04% in a general surgical population^{1,6} and 0.4% to 0.1% in obstetrical patients.^{1,12} Unfortunately, no studies have documented the rate of the problem as defined by the American

*Deller A, Schreiber MD; Gramer J, and Ahnefeld FW.

Difficult intubation: Incidence and predictability. A prospective study of 8,284 adult patients. *Anesthesiology* 1990; 73: A1054 (Abstract).

Society of Anesthesiology practice guidelines (difficult tracheal intubation with four or more attempts or more than ten minutes required).³ The present study identified 16 of 3,325 (0.5%) who required four or more laryngoscopies, but the time was not recorded.

Only one small study has examined the relationship of different definitions. Samsoon retrospectively examined 13 patients who were tracheal intubation failures.¹ In 12 of these patients, only the tip of the epiglottis or no epiglottis was visualized. These findings are similar to the present study where all three patients who were failures were noted to be GRADE 4: no epiglottis visualized.

One of the reasons for the high rate of poor view at laryngoscopy in our study may be related to the confusion between the modified GRADE 3 diagrams on the anaesthetic record and the original definition used by Cormack and Lehane. The original Cormack and Lehane diagram for GRADE C view, equivalent to GRADE 3, showed that only the epiglottis and none of the glottis was visible. However, GRADE 3 in the modified diagrams shows a darkened area in the centre which could be interpreted as a partial view of the laryngeal aperture. With this confusion, anaesthetists may have indicated GRADE 3 on the modified diagram when by the original definition, the view was GRADE 2. Other studies have also added to this confusion by altering the definition for grading the view at laryngoscopy. Mallampati scored patients as GRADE 3 more liberally and included patients in whom the glottis could not be exposed but the corniculate cartilages were visualized.¹⁵ However, Samsoon and Young used an even more rigorous definition for GRADE 3: only the tip of the epiglottis visible.¹ The incorrect documentation of true GRADE 2 as GRADE 3 on the modified diagrams of our anaesthetic record could account for the higher frequency of poor view at laryngoscopy noted in our study.

It was unclear on our anaesthetic record whether the grading system for view at laryngoscopy documented by the anaesthetist was the initial view or the best view. Others have noted that laryngeal pressure, changing laryngoscope blades, and changing neck position can alter the view at laryngoscopy.^{9,16} If these manoeuvres were not used in the present study, this could account for the higher frequency of poor views noted in our study compared to several other studies. A survey of 120 British anaesthetists adds to the confusion.¹⁷ Over half of the anaesthetists interviewed incorrectly used the grading system as originally defined by Cormack and Lehane.

Future studies on risk factors to identify the difficult airway will be impossible to interpret if the outcome is not clearly defined and clinically meaningful. Our own

INTUBATION:

- | | | |
|----------------------------------|-------------------------------------|------------------------------------|
| <input type="checkbox"/> asleep | <input type="checkbox"/> direct | <input type="checkbox"/> oral |
| <input type="checkbox"/> awake | <input type="checkbox"/> blind | <input type="checkbox"/> nasal R L |
| <input type="checkbox"/> in situ | <input type="checkbox"/> fiberoptic | <input type="checkbox"/> trach |

- | | |
|--|---|
| <input type="checkbox"/> rapid sequence (RSI) | <input type="checkbox"/> blade - 3MAC or |
| <input type="checkbox"/> pre-oxygenation | <input type="checkbox"/> stylet used |
| <input type="checkbox"/> equal A/E | <input type="checkbox"/> cricoid pressure (not RSI) |
| <input type="checkbox"/> no trauma | # of laryngoscopy |
| <input type="checkbox"/> easy mask ventilation | attempts |

- DIFFICULT EASY AWKWARD

BEST VIEW AT LARYNGOSCOPY: (Include for FO)

- all of vocal cords
 partial view of vocal cords
 arytenoids only
 epiglottis only
 no view of epiglottis

FIGURE 4 Revised anaesthetic record to document airway difficulty. The successful method of tracheal intubation, ease of mask ventilation, type of laryngoscope blade, use of stylet and/or pressure, and number of laryngoscopy attempts are noted. Best view at laryngoscopy is divided into five categories, each concisely defined.

study has shown wide variation in the rate of difficult airway according to the definition used even though diagrams were included directly on the anaesthetic record. For this reason we have subsequently revised our anaesthetic record. We have removed reference to the grading system as well as the modified Cormack and Lehane diagrams from the record. Instead, we have added a simple verbal description of the view at laryngoscopy for five different observations similar to those noted by Wilson and Oates (Figure 4).^{9,11} We have also indicated on the new anaesthetic record that laryngoscopy view should be recorded when all manoeuvres have been completed to achieve the best possible view. Other indicators of difficulty at laryngoscopy including number of laryngoscopy attempts, need for external pressure, and the size and type of blade are also included. It may also be worthwhile to identify specifically the laryngoscopist with level of training and include this information on the tracheal intubation record. We hope that these modifications will improve the consistency of recording and provide a more accurate tracheal intubation assessment for future laryngoscopists.

This study highlights the need for agreement among anaesthetists for the definition of the difficult airway. Better methods for documentation are needed as part of the standard anaesthetic record used in all hospitals. In addition, more training on the application of the consen-

sus definitions may be helpful. Accurate and meaningful documentation of the "extent of the problem" is needed for both future laryngoscopists in clinical practice and for studies which attempt to identify risk factors.

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