E. Andrew Ochroch MD,*
Judd E. Hollander MD,†
Scott Kush MPH,†
Frances S. Shofer PhD,†
Richard M. Levitan MD†

Assessment of laryngeal view: Percentage of glottic opening score *vs* Cormack and Lehane grading

Purpose: To examine the intra- and inter-rater reliability of two methods that categorize laryngeal view during direct laryngoscopy, the Cormack-Lehane grading system and a new scale, the percentage of glottic opening (POGO) scale.

Methods: Seven anesthesiologists from the University of Pennsylvania Health System viewed 25 identical pairs of slides of laryngeal views during direct laryngoscopy. Each anesthesiologist rated the 50 slides for both Cormack-Lehane grades and POGO scores. The latter CL replaces grades 1 and 2 C-L grades with a percentage of glottic opening: the POGO score. Inter and intra-physician reliability for the Cormack-Lehane grades were determined using the kappa statistic analysis, comparison of POGO scores was performed using the intraclass correlation coefficients (r_i).

Results: The POGO score had a better inter and intra-physician reliability than the Cormack-Lehane grading system. The intra-physician reliability for the POGO score was very good with an average interclass r_i value of 0.88. The inter-physician score was good with a r_i of 0.73. The Cormack-Lehane grading system had excellent intra-physician concordance (average kappa = 0.83.) but the inter-physician reliability was poor (kappa = 0.16.)

Conclusion: The Cormack-Lehane grading system has very poor inter-physician reliability. The lack of inter-physician reliability with Cormack-Lehane grading calls into question the results of previous studies in which different laryngoscopists used this method to assess laryngeal view. The POGO score appears to have good intra and inter-rater reliability. It has several theoretical advantages and may prove to be more useful for research studies in direct laryngoscopy.

Objectif : Vérifier la fiabilité intra et interobservateur de deux méthodes de classification de la vue du larynx pendant la laryngoscopie directe : le système de cotation de Cormack-Lehane et une nouvelle échelle, le pourcentage d'ouverture glottique (POG).

Méthode : Sept anesthésiologistes de l'University of Pennsylvania Health System ont visionné 25 paires identiques de diapositives du larynx sous laryngoscopie directe. Chaque anesthésiologiste a coté les 50 diapositives selon les échelons Cormack-Lehane et les scores POG. Cette dernière échelle remplace les rangs 1 et 2 C-L par un pourcentage d'ouverture glottique : le score POG. La fiabilité inter et intraobservateur des rangs Cormack-Lehane a été déterminée par une analyse statistique kappa, la comparaison des scores POG a été réalisée en utilisant des coefficients de corrélation interclasses (r_i).

Résultats : Le POG a fourni une meilleure fiabilité inter et intraobservateur que le système de cotation Cormack-Lehane. La fiabilité intraobservateur du score POG a été très bonne, la valeur interclasse moyenne r_i étant de 0,88. Le score interobservateur a été bon selon un r_i de 0,73. Le système de Cormack-Lehane a donné une excellente concordance intraobservateur (kappa moyen = 0,83) mais la fiabilité interobservateur a été pauvre (kappa = 0,16).

Conclusion : Le système de cotation Cormack-Lehane a présenté une très pauvre fiabilité interobservateur. Cette lacune remet en question les résultats d'études antérieures où différents médecins ont utilisé la méthode pour évaluer la vue du larynx. Le score POG semble avoir une bonne fiabilité intra et interévaluateur. Il présente certains avantages théoriques et peut se révéler plus utile lors de recherches en laryngoscopie directe.

STANDARD laryngoscopy results in successful intubation more than 99% of cases.[1] To demonstrate statistical differences in laryngoscopy techniques would require sample sizes of tens of thousands of patients if failed intubation is the only outcome measure. Laryngeal view has been used as a surrogate marker in laryngoscopy research, but the standard means of describing laryngeal view, Cormack and Lehane (CL) grading, has never been validated.[2,3]

Numerous authors have made attempts to refine CL grading for their particular studies.[4-6] Aware of previous work that sought to quantify how much of the glottis is actually seen, we proposed and tested the inter and intra-observer consistency of a new method for assessing laryngeal view. The method we propose takes CL grades 1 and 2 and replaces them with a percentage of glottic opening: the POGO score. A POGO score of 100% denotes visualization of the entire glottic opening in linear fashion from the anterior commissure to the posterior cartilages (Figure 1). If none of the glottic opening is seen, then the POGO score is 0%. This method had excellent intra and inter-rater reliability when used by emergency physicians.[7] The purpose of the present study was to assess the inter- and intra-rater reliability of the POGO score vs CL grading in a group of academic anesthesiologists already familiar with CL grading.

Methods

Slide images were made from a commercially available videotape (Airway Cam Volume 1: Orotracheal Intubation; Airway Cam Technologies, Wayne PA).[8] The videotape was made using a head-mounted camera that captures the laryngoscopist's monocular perspective.[9] Twenty-five images ranging from no glottic visualization (POGO = 0%) to full glottic visualization (POGO = 100%) were selected. The slides were then exactly reproduced and 50 slides (25 images, 2 copies each) were randomly inserted into a carousal.

Seven attending anesthesiologists from the Hospital of the University of Pennsylvania participated. They had an average of nine years of attending practice (range 1->20 yr). They were unaware of the goals and objectives of the study, and were not told that the slides would appear more than once. They were instructed to estimate the percentage of glottic opening based upon the amount of the glottic opening seen using the span from anterior commissure to the interarytenoid notch as 100%. To facilitate and insure instruction, they were shown Figure 1. Cormack-Lehane grading was briefly reviewed as described and drawn by Cormack and Lehane in their original articles.[2,3]
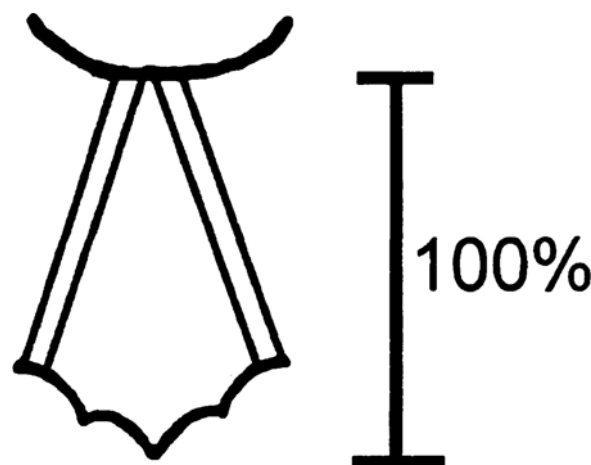

FIGURE 1 The percentage of glottic opening (POGO) score represents the portion of the glottis visualized. It is defined anteriorly by the anterior commissure and posteriorly by the interarytenoid notch. The score ranges from 0% when none of the glottis is seen to 100% when the entire glottis including the anterior commissure is seen.

Each slide was projected from a distance of seven feet for 15 sec. Each physician recorded the POGO score and CL grade for each slide, blinded to the other participants' responses. No repeat viewing was allowed.

The intra-class correlation coefficient, r_I, was used to determine the intra and inter physician reliability for the POGO scores. For CL grading, the intra and inter-physician reliability was assessed using the kappa statistic. Data were analyzed using SAS 6.12 statistical software (SAS Institute, Cary, NC, 1996).

The study was approved by the institutional review board.

Results

The intra-physician reliability of POGO scores (how well one physician's two scorings of the same slide agreed) was very good. The range of r_I values was 0.77 to 0.94 with a mean r_I of 0.88. The inter-physician reliability (how well the physicians agreed with each other) was good with an r_I of 0.73. (Figure 2).

The intra-physician agreement for the CL grading scale was excellent. Kappa values ranged from 0.64 to 1.0 with a mean of 0.83. Conversely, the interphysician concordance for the CL grading scale there was very poor (k = 0.16).

To ensure that a single physician was not responsible for the poor interphysician concordance noted using the CL grade, a pair-wise analysis was performed. These
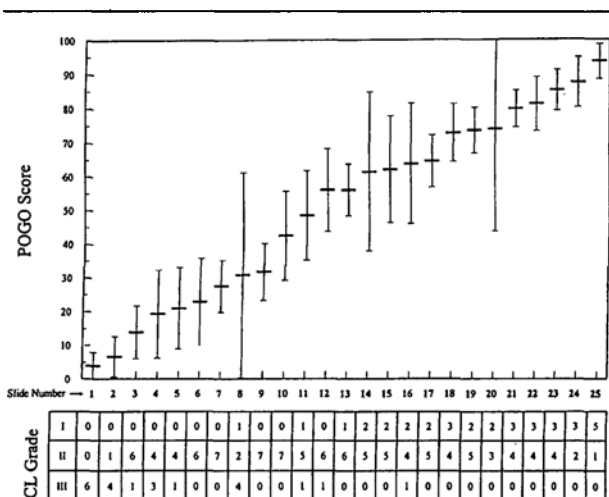
FIGURE 2 Assignation of the POGO score and the Cormack-Lehane (CL) grade in the 25 slides, by the anesthesiologists. The heavy horizontal bar above each slide number represents the overall mean POGO scores (the average of the average of two scores from each of seven physicians) and the error bars are the standard deviation. The slides have been arranged from lowest to highest mean POGO scores. The assigned CL grades below each slide number are one of two CL grades assigned by the seven anesthesiologists to each slide. Note, in six of 25 slide pairs one or more anesthesiologist did not assign a CL grade because of ambiguous visualization of landmarks.

sometimes be well delineated even though the vocal cords are not explicitly seen. This is because of the bulb position on a curved blade and shadowing created by the epiglottis. POGO scoring also has the advantage of being a continuous numerical scale that allows for much finer distinction between different laryngeal views. In terms of statistical analysis and the ability to distinguish differences in techniques or equipment a continuous numerical scale is easier to use and more likely to demonstrate statistical significance.

The are several limitations of the POGO score and our study design. The POGO score does not differentiate between visualization of the epiglottis and the tongue. In each case the POGO score would be 0. While this limitation could be addressed with descriptive sub-categorization, we did not examine this in the study. We used static views of the larynx that may not correlate with dynamic views obtained within the time constraints of the procedure. Finally, in six of 25 slide pairs one or more participants did not assign a CL grade because of ambiguous visualization of landmarks.

The POGO score is a simple, easy way to categorize laryngeal view. It has better inter-physician reliability than CL grading and may be more useful for statistical analysis. Its potential as a research tool is being assessed with studies of its reproducibility during actual (dynamic) laryngoscopy and assessment of the relationship between POGO score and difficulty of intubation.

results were consistent with the comparison of the group as a whole. Kappa scores ranged from 0.12 to 0.5 with a mean of 0.28, which remains very poor.

Discussion

Our previous work found that CL grading by emergency physicians was not reliable.[7] One possible explanation is that emergency physicians were not familiar with CL grading. In the present study, we examined the intra- and inter-rater reliability in seven anesthesiologists who use CL grading routinely. Compared with emergency physicians, the anesthesiologists in this study had higher mean intra-physician agreement (k = 0.83 *vs* 0.71), but lower inter-physician agreement (k = 0.16 *vs* 0.59).[8] These results question the validity of earlier studies involving multiple laryngoscopists that have utilized CL grading as an outcome measure.

The POGO score has several theoretical advantages over CL grading. The POGO score, unlike CL grading, does not depend on visualization of the vocal cords *per se*. It is a measure of how much of the glottic opening is seen, regardless of whether the true cords are identifiable. Our experience is that the glottic opening can

References

1 *Benumof JL.* Definition and incidence of the difficult airway. *In:* Benumof JL (Ed.). Airway Management: Principles and Practice. St. Louis: Mosby-Yearbook, 1996: 124.

2 *Cormack RS, Lehane J.* Difficult tracheal intubation in obstetrics. Anaesthesia 1984; 39: 1105–11.

3 *Williams KN, Carli F, Cormack RS.* Unexpected difficult laryngoscopy: a prospective survey in routine general surgery. Br J Anaesth 1991; 66: 38–44.

4 *Wilson ME, Spiegelhalter D, Robertson JA, Lesser P.* Predicting difficult intubation. Br J Anaesth 1988; 61: 211–6.

5 *Benumof JL, Cooper SD.* Quantitative improvement in laryngoscopic view by optimal external laryngeal manipulation. J Clin Anesth 1996; 8: 136–40.

6 *Takahata O, Kubata M, Mamiya K, et al.* The efficacy of the "BURP" maneuver during a difficulty laryngoscopy. Anesth Analg 1997; 84: 419–21.

7 *Levitan RM, Ochroch EA, Kush S, Shofer FS, Hollander JE.* Assessment of airway visualization: validation of the percentage of glottic opening (POGO) scale. Acad Emerg Med 1998; 5: 919–23.

8 *Doyle DJ.* Video review—Orotracheal intubation. Produced by Levitan RM, Higgins MS. Can J Anesth 1998; 45: 288.

9 *Levitan, RM.* Direct laryngoscopy imaging: teaching and research applications. Educational Synopses in Anesthesiology and Critical Care Medicine (June, 1998): The On-line Anesthesia Journal, at http://gas-net.med.yale.edu/esia/1998/june/samart.html. Reprinted in Am J Anesthesiology 1999; 26: 39–42.