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Change in glottic view during intubation using a KoMAC videolaryngoscope

A retrospective analysis

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Abstract

Intubation with videolaryngoscopy has become popular in various clinical settings. However, despite the use of a videolaryngoscope, difficult intubation still exists and intubation failure has been reported. This retrospective study assessed the efficacy of the 2 maneuvers in improving the glottic view during videolaryngoscopic intubation. The medical records of patients who underwent videolaryngoscopic intubation and whose glottal images were stored in electronic medical charts were reviewed. The videolaryngoscopic images were divided into 3 categories according to the applied optimization techniques as follows: conventional method, with the blade tip located in the vallecular; backward-upward-rightward pressure (BURP) maneuver; and epiglottis lifting maneuver. Four independent anesthesiologists scored the visualization of the vocal folds using the percentage of glottic opening (POGO, 0–100%) scoring system. A total of 128 patients with 3 laryngeal images were analyzed. The glottic view was the most improved in the epiglottis lifting maneuver among all the techniques. The median POGO scores were 11.3, 36.9, and 63.1 in the conventional method, BURP, and epiglottis lifting maneuver, respectively ($P < .001$). There were significant differences in the distribution of POGO grades according to the application of BURP and epiglottis lifting maneuvers. In the POGO grades 3 and 4 subgroups, the epiglottis lifting maneuver was more effective than the BURP maneuver in improving the POGO score Inadequate visualization of the vocal folds occurred even when intubation was performed using a videolaryngoscope. The application of optimization maneuvers, such as BURP and epiglottis lifting by the blade tip, could improve the glottic view.

Abbreviations: BURP = backward-upward-rightward pressure, IQR = interquartile range, POGO = the percentage of glottic opening.

Keywords: BURP, epiglottis lifting, glottic view, intubation, videolaryngoscopy

1. Introduction

A difficult unanticipated airway is a critical condition, and intubation failure is a major cause of poor outcomes related to primary airway problems.[1] In 2015, the Difficult Airway Society updated the 2004 guidelines for the management of difficult intubation and highlighted the role of videolaryngoscopy.[2] Videolaryngoscopy is known to improve the glottal view and to reduce tracheal intubation attempts and laryngeal trauma compared with conventional laryngoscopy.[3] Furthermore, the coronavirus disease 2019 pandemic is threatening healthcare professionals involved in the airway management of critically ill patients with infection, and using a videolaryngoscope is recommended to reduce the risk of contamination with airway secretions during intubation.[4]

However, there are several limitations to consider when using a videolaryngoscope. Despite the use of a videolaryngoscope, passage of the endotracheal tube was difficult in 10.5% of cases, and 0.5% of intubation failures were reported.[5,6] In addition, the definition of difficult intubation has not yet been elucidated, and the Cormack and Lehane grading system appears inadequate for videolaryngoscopy.[7] Also, it has not known how the inadequate visualization of vocal folds can be improved efficaciously during videolaryngoscopic intubation.

This retrospective study analyzed glottal images captured during videolaryngoscopic intubation. Thereafter, the efficacy of 2 maneuvers in improving glottic visualization during videolaryngoscopy intubation, the backward-upward-rightward pressure (BURP) maneuver and the epiglottis lifting maneuver, were assessed.

2. Methods

With the approval of the institutional review board (B-2104/676–102, March 30, 2021), the electronic medical

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The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

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records from April 2020 to February 2021 were reviewed retrospectively. The requirement for informed consent was waived.

2.1. Videolaryngoscopic intubation practice

General anesthesia was administered conventionally. Tracheal intubation was performed using a KoMAC videolaryngoscope (KoMAC Co., Ltd., Seoul, Republic of Korea) by experienced anesthesiologists familiar with the videolaryngoscope. The KoMAC videolaryngoscope has adjustable curved MAC blades (size 3 or 4). Unless otherwise specified, 3 and 4 blades were used for laryngoscopy in female and male patients, respectively. Experienced anesthesiologists were defined as having at least 5 years of experience in anesthesia and having performed at least 100 intubations with this device.[8]

When it was necessary to improve the glottic view during videolaryngoscopic intubation, an optimization maneuver, such as BURP or direct lifting of the epiglottis using a blade tip, was used. The images were divided into the following 3 categories according to the applied maneuvers: Conventional method with the blade tip located in the vallecula; BURP maneuver, and; Epiglottis lifting maneuver. It was not recorded whether lifting traction was applied during the entire intubation process.

2.2. Inclusion and exclusion criteria

The medical records of adult patients who underwent intubation using a KoMAC videolaryngoscope and whose 3 glottal images with descriptions were stored in an electronic medical chart were used in this study. The exclusion criteria were patients whose glottal images did not exist in the medical records, patients whose intubation was performed by an inexperienced anesthesiologist, or patients with any disease with alterations in the laryngeal anatomy.

2.3. Assessment of vocal cord visualization and outcome variables

With the recorded videolaryngoscopic images, visualization of the glottis was scored using the percentage of glottic opening (POGO, 0–100%) scoring system[9] by 4 anesthesiologists with 5 to 10 years of work experience skilled in laryngoscopy. The numerical averages of the 4 scores were recorded for each image. Subsequently, the scores were classified as follows: grade 1, POGO ≥ 75%; grade 2, 50% ≤ POGO < 75%; grade 3, 25% ≤ POGO < 50%; and grade 4, POGO < 25%. The main outcomes were the POGO scores of the groups and proportion of each grade based on the POGO score.

2.4. Statistical analysis

The data were analyzed using SPSS for Windows (ver. 25; IBM Corp., Armonk, NY). After the normality check of variables using the Shapiro–Wilk test, the Friedman test was used to compare the mean POGO scores with each manipulation technique. To compare the differences among the 3 groups, a Wilcoxon signed-rank test using Bonferroni correction was employed. A P value of < .017 (0.05/3) was considered statistically significant because of multiple comparisons. Categorical data were analyzed using Cochran's Q test, and the McNemar test was used as a Bonferroni correction tool to identify differences in the POGO grade distribution. Statistical significance was considered when a P value < .017 (0.05/3) was observed in the comparison among the 3 groups and a P value < .008 (0.05/6) was observed in the comparison within groups. The obtained data are expressed as median (interquartile range) and number (%).

3. Results

A total of 128 patients had all 3 glottic images: 1 image recorded during the conventional method and 2 images recorded after applying the BURP and epiglottis lifting maneuver, respectively. These 128 sets composed of 3 images were analyzed to identify the effect of optimization maneuvers on the improvement in glottal views. (Fig. 1). The characteristics of patients were presented in Table 1. When the images observed using the conventional videolaryngoscopic method were analyzed, the distributions of POGO grades 1, 2, 3, and 4 were 0%, 11%, 23%, and 66%, respectively.

The POGO scores (median interquartile range) were 11.3 (0.00–32.5), 36.9 (15.6–63.4), and 63.1 (45.3–77.5) in the conventional method, BURP, and epiglottis lifting maneuvers, respectively (Fig. 2A; P < .001). Figure 2B showed the distribution of POGO grades according to maneuver application. The proportion of grade 1 was 0% in the conventional method, which increased to 13% during the BURP maneuver and 34% during the epiglottis lifting maneuver. The incidence of grade 2 was also higher in the BURP (30%, P = .001) and epiglottis lifting maneuvers (39%, P < .001) than in the conventional method (11%). While the proportion of POGO grade 4 in the conventional method was the highest (66%), it decreased in the

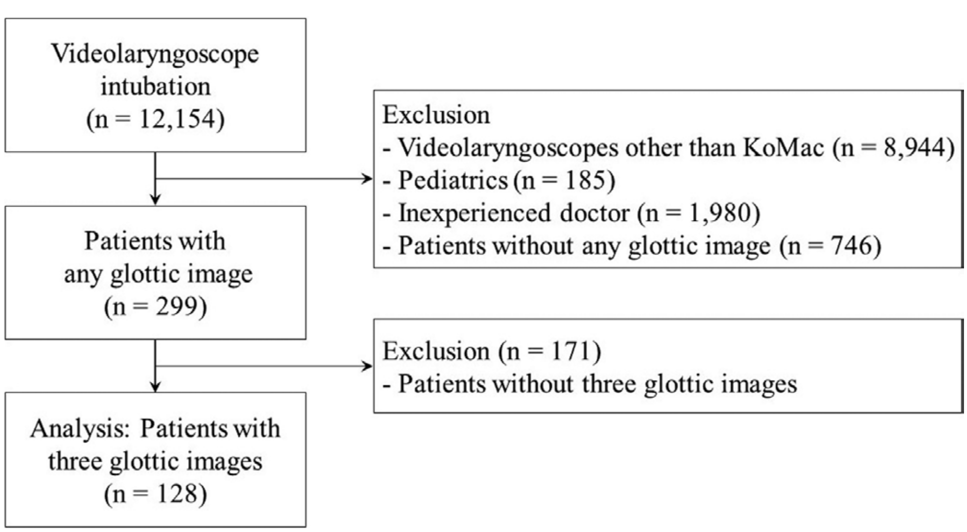

Figure 1. Flowchart of patient recruitment.

Table 1

The characteristics of 128 patients.

Age (yr)	59 (53–67)
Male/female	59/70 (46%/54%)
Weight (kg)	63(57–73)
Height (cm)	161 (154–170)
BMI (kg/m^2)	25 (22–26)
ASA 1/2/3	49/78/1 (38%/61%/1%)
POGO grade 1/2/3/4*	0/14/29/85 (0%/11%/23%/66%)
POGO 0*	33 (26%)

Data are expressed as median (IQR) and number (%). 128 patients who had 3 videolaryngoscope images of the conventional method, BURP, and the epiglottis lifting maneuver. Grade 1, 75%≤ POGO; grade 2, 50%≤ POGO < 75%; grade 3 25%≤ POGO < 50%; grade 4, POGO < 25%.
ASA = American society of anesthesiology physical status, BMI = body mass index, BURP = backward-upward-rightward pressure, POGO = percentage of glottic opening.
* Results observed in the conventional method with the blade tip located in the vallecula.

videolaryngoscopy is advantageous for the intubation of nondifficult airways.[10] However, even if a videolaryngoscope is used, an appropriate glottic view cannot be secured in some cases.[11]

The optimization maneuvers used in this study to improve glottic visualization were BURP and direct epiglottic lifting. The BURP maneuver was first described by Knill in 1993 in a case of difficult laryngoscopy to improve the view of the glottis.[12] This technique can be easily applied during intubation by manipulating the larynx with 3 pressures: backward, upward, and rightward. During videolaryngoscopic intubation, the BURP maneuver forces the larynx downward, thereby bringing the vocal cords into view. Thus, the BURP maneuver provides better glottic visualization than conventional videolaryngoscopy, and may be a useful technique for difficult videolaryngoscopy.

In the present study, a more effective technique than BURP was to lift the epiglottis directly using the blade tip of the vid-

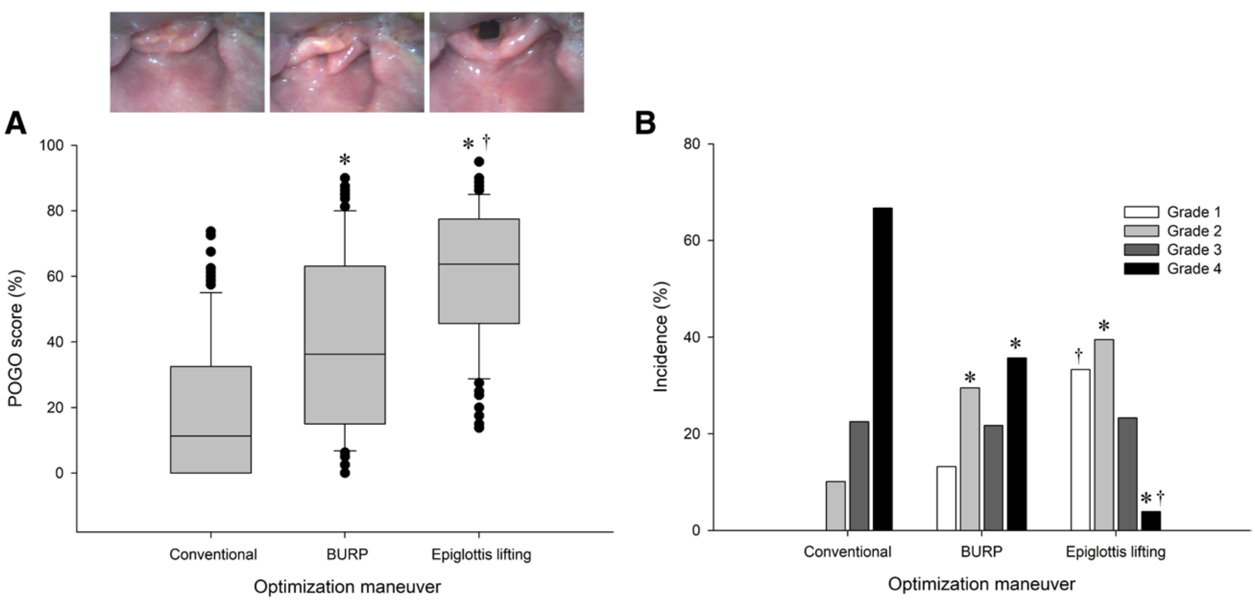

Figure 2. POGO grades and scores of 128 patients. (A) The distribution of POGO grade and (B) the POGO scores in each optimization maneuver. The top 3 representative images (B) were obtained from 1 patient. Grade 1, POGO ≥ 75%; grade 2, 50% ≤ POGO < 75%; grade 3, 25% ≤ POGO < 50%; grade 4, POGO < 25%. *P < .017 compared with the conventional method. †P < .017 compared with BURP maneuver. BURP = backward-upward-rightward pressure, POGO = percentage of glottic opening.

BURP (35%) and epiglottis lifting maneuver (4%) (P < .001). The incidence of a POGO score of 0, which meant invisible vocal folds, was 26%, 2%, and 0% in the conventional method, BURP, and epiglottis lifting maneuvers, respectively.

POGO grades 2, 3, and 4 in the conventional method were observed in 14, 29, and 85 patients, respectively, and they were classified into 3 subgroups. BURP and epiglottic lifting maneuver significantly improved the POGO scores in all subgroups (Fig. 3A–C). In particular, in the POGO grades 3 and 4 subgroups, the epiglottis lifting maneuver was more effective than the BURP maneuver in improving the POGO score (Fig. 3B and C).

4. Discussion

In the present study, inadequate visualization of the glottis was observed despite the use of a videolaryngoscope, which was improved by applying optimization maneuvers, such as BURP and the direct epiglottis lifting maneuver. The most effective technique for improving the glottic view was the epiglottis lifting maneuver.

Videolaryngoscopy is recommended for the management of difficult airways.[2] Furthermore, it has been reported that eolaryngoscope to improve the glottic visualization. In general, direct lifting of the epiglottis with a straight blade is used in pediatric intubation because of the long and floppy epiglottis.[13] Conventionally, proper head positioning is required for the 3 airway axes to be as straight as possible, and a curved laryngoscope blade in the vallecula pulls the epiglottis forward to expose the larynx. While using a videolaryngoscope, a camera lens is located near the end of the blade at an angle of 50° to 60° in the pharynx area.[14] When viewing the glottis through the videolaryngoscope camera lens, the epiglottis can be a representative barrier that needs to be removed from the view. Therefore, the POGO score of the epiglottis lifting group was significantly higher in patients who initially had an inadequate glottic view.

Similarly, Oh et al[15] also reported that direct lifting of the epiglottis provided a better glottic view than indirect lifting when intubating using a videolaryngoscope. The first difference in this study was that the BURP maneuver was additionally evaluated, and we found that the greatest improvement in the glottal view was observed in the epiglottis lifting maneuver compared to the conventional method and BURP maneuvers. The second difference is that more patients with a difficult airway seemed to be included in the present study. when comparing the initial POGO score between the 2 studies, the median

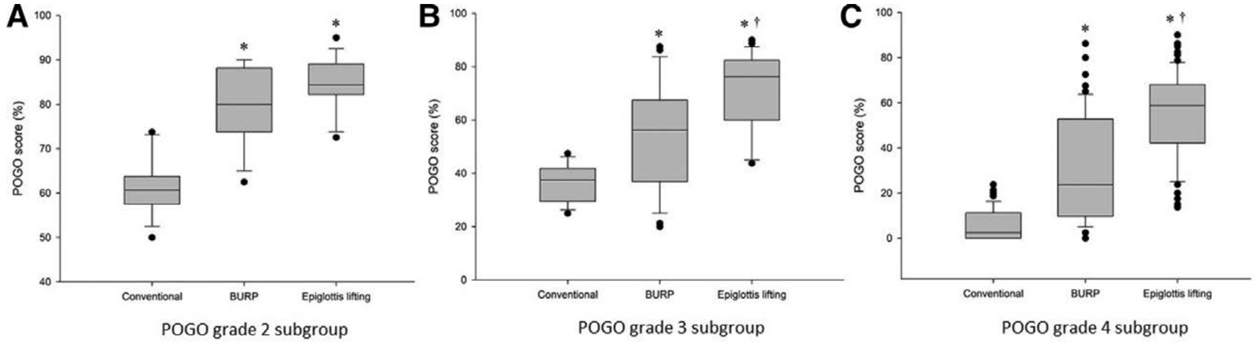

Figure 3. Changes of POGO score in each POGO grade subgroups. (A) POGO grade 2 subgroup (n = 14); (B) POGO grade 3 subgroup (n = 29); (C) POGO grade 4 subgroup (n = 85). Subgroups were classified according to the POGO grade measured by the conventional method. *$P < .001$ compared to the conventional method. †$P < .001$ compared to the BURP maneuver. BURP = backward-upward-rightward pressure, POGO = percentage of glottic opening.

POGO score of the present study was 11.3% during the conventional approach by a videolaryngoscope, while the mean POGO score was 64.4% before the direct lifting of the epiglottis.[15] The reason why is that a videolaryngoscope has been primarily used for patients with a previous history or any potential risk of difficult intubation in our institution. Specifically, in the POGO grade 3 or 4 subgroups, the epiglottis lifting maneuver was better than the BURP maneuver in terms of improving the glottic view. However, epiglottis lifting was not superior to BURP maneuver in the POGO grade 2 subgroup. This means that the epiglottis lifting maneuver is more effective than the BURP maneuver in improving glottic visualization in patients with a difficult airway. Further studies should evaluate whether the concurrent application of BURP and epiglottis lifting causes additional changes in POGO scores.

It is not clear whether the POGO score is directly related to intubation difficulty. Gu et al[16] reported that intubation was faster and easier in a deliberately restricted laryngeal view. However, it is generally considered that the better the glottic view of the POGO score or the Cormack and Lehane grading system, the easier the intubation. At present, the difficulty of intubation, such as the time required for intubation and the number of attempts, could not be investigated, which is the first limitation of this study. Considering that the median POGO score was 11.3% and the incidence of POGO score 0 was 25.8%, a large number of patients with difficult airways were included. It is necessary to confirm whether an improvement in the glottic view leads to an increase in the intubation success rate or an improvement in intubation quality. Second, only the KoMac videolaryngoscope was used. Because various types of videolaryngoscopes are currently used, our results cannot be generalized to these devices. The length, width, and curvature of the videolaryngoscope blade varied slightly between manufacturers. The height and weight of the patient should be considered when selecting blade size. Whether similar results can be obtained when other videolaryngoscopes are used should be confirmed. Third, because of its retrospective nature, we could not collect detailed data regarding airway complications, such as sore throat, hoarseness, bleeding, or other trauma. It is presumed that there were no serious postintubation complications, as there were no cases in which additional management or extension of hospitalization was required owing to intubation or airway problems. Finally, the selection bias of retrospective data cannot be overlooked. BURP and epiglottis lifting would have been additionally performed for patients with a low POGO score in a conventional view, and it was highly likely that they were included in this study. This is the reason why patients presented relatively low POGO scores in the conventional view. In addition, several types of videolaryngoscopes have been used in our center. Some do not have a picture capturing function, and all of these data using other videolaryngoscopes could not be included in this study.

In conclusion, inadequate visualization of the glottis may occur during videolaryngoscopic intubation, and the application of an optimization maneuver can improve visualization. When using the KoMac videolaryngoscope, the lifting epiglottis maneuver was more effective in improving the glottic view than the BURP maneuver in patients expected to have a difficult airway. Larger clinical trials using various types of videolaryngoscopy are required to generalize our findings.

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References

[1] Cook TM, Woodall N, Frerk C, et al. Major complications of airway management in the UK: results of the fourth national audit project of the royal college of anaesthetists and the difficult airway society. Part 1: anaesthesia. Br J Anaesth. 2011;106:617–31.
[2] Frerk C, Mitchell VS, McNarry AF, et al. Difficult airway society 2015 guidelines for management of unanticipated difficult intubation in adults. Br J Anaesth. 2015;115:827–48.
[3] Lewis SR, Butler AR, Parker J, et al. Videolaryngoscopy versus direct laryngoscopy for adult patients requiring tracheal intubation: a Cochrane Systematic Review. Br J Anaesth. 2017;119:369–83.
[4] Cook TM, El-Boghdadly K, McGuire B, et al. Consensus guidelines for managing the airway in patients with COVID-19: guidelines from the difficult airway society, the association of anaesthetists the intensive care society, the faculty of intensive care medicine and the royal college of anaesthetists. Anaesthesia. 2020;75:785–99.
[5] Falcetta S, Sorbello M, Giacinto DI, et al. Easy to see does not mean easy to perform: rigid video stylet vs videolaryngoscope. Minerva Anestesiol. 2021;87:495–7.
[6] Aziz MF, Healy D, Kheterpal S, et al. Routine clinical practice effectiveness of the glide scope in difficult airway management: an analysis of 2,004 Glidescope intubations, complications, and failures from two institutions. Anesthesiology. 2011;114:34–41.
[7] Norris A, Heidegger T. Limitations of videolaryngoscopy. Br J Anaesth. 2016;117:148–50.

[8] Mulcaster JT, Mills J, Hung OR, et al. Laryngoscopic intubation: learning and performance. Anesthesiology. 2003;98:23–7.
[9] Ochroch EA, Hollander JE, Kush S, et al. Assessment of laryngeal view: percentage of glottic opening score vs Cormack and Lehane grading. Can J Anaesth. 1999;46:987–90.
[10] Liu DX, Ye Y, Zhu YH, et al. Intubation of non-difficult airways using video laryngoscope versus direct laryngoscope: a randomized, parallel-group study. BMC Anesthesiol. 2019;19:75.
[11] Stroumpoulis K, Pagoulatou A, Violari M, et al. Videolaryngoscopy in the management of the difficult airway: a comparison with the Macintosh blade. Eur J Anaesthesiol. 2009;26:218–22.
[12] Knill RL. Difficult laryngoscopy made easy with a "BURP". Can J Anaesth. 1993;40:279–82.
[13] Passi Y, Sathyamoorthy M, Lerman J, et al. Comparison of the laryngoscopy views with the size 1 Miller and Macintosh laryngoscope blades lifting the epiglottis or the base of the tongue in infants and children <2 yr of age. Br J Anaesth. 2014;113:869–74.
[14] Angadi SP, Frerk C. Videolaryngoscopy and cormack and lehane grading. Anaesthesia. 2011;66:628–9.
[15] Oh JY, Lee JH, Kim YY, et al. A comparative study of glottis visualization according to the method of lifting the epiglottis in video laryngoscopy: indirect and direct lifting methods. Anesth Pain Med (Seoul). 2021;16:196–200.
[16] Gu Y, Robert J, Kovacs G, et al. A deliberately restricted laryngeal view with the glide scope (R) video laryngoscope is associated with faster and easier tracheal intubation when compared with a full glottic view: a randomized clinical trial. Can J Anaesth. 2016;63:928–37.