Original Article

Comparison of Videolaryngoscopy and Direct Laryngoscopy for Nasogastric Tube Placement

Vijitpavan A, MD[1], Ruananukun N, MD[1], Chaiboon P, MD[1]

[1] Department of Anesthesiology, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

Background: Nasogastric tube (NGT) placement can be accomplished using a blind technique, but the failure rate is high, especially in anesthetized and tracheally intubated patients. Practically, mouth opening with a direct laryngoscopy is the alternative method attempted for guiding the NGT under direct visualization. However, limitations of this approach include the narrowing of the oral space and limited periglottic view, which should be resolved by using videolaryngoscope.

Objective: To compare the success rate of a videolaryngoscope (C-MAC D-Blade; Karl Storz, Tuttlingen, Germany) with a direct laryngoscope for NGT insertion.

Materials and Methods: Eighty-four adult patients were enrolled in the study and randomized into two groups, the videolaryngoscopy group and the direct laryngoscopy group. After induction of anesthesia and tracheal intubation, the participants in the videolaryngoscopy group and direct laryngoscopy group underwent laryngoscopy using a C-MAC D-Blade and Macintosh blade, respectively. The time from entrance of the NGT into the nostril until confirmation of the proper tip position was recorded and defined as successful insertion. The number of attempts was defined as the number of times the tube was withdrawn from the nostril and reinserted. Placement more than three times was defined as procedure failure. Bleeding was also observed.

Results: The videolaryngoscopy group had a significantly higher success rate at the first attempt than the direct laryngoscopy group (78.57% versus 30.95%, respectively; p<0.001). The mean time for NGT insertion in the videolaryngoscopy group was significantly shorter than in the direct laryngoscopy group (80 versus 170 seconds, respectively, p<0.01). Direct laryngoscopy failed in five cases, however, all were successful by subsequent videolaryngoscopy. Videolaryngoscopy failed in two cases, but tube insertion was eventually successful by placement of a guide wire in the NGT. Bleeding occurred in 40.48% and 4.76% of patients in the direct laryngoscopy and videolaryngoscopy groups, respectively. The difference was statistically significant.

Conclusion: Videolaryngoscopy is easier and faster for NGT placement and is associated with a lower incidence of bleeding complications and a higher success rate. Therefore, this method should be considered as an alternative option when encountering difficulty inserting the NGT using the conventional technique.

Trial registration: Thai Clinical Trials Registry, TCTR 20161104002

Keywords: Videolaryngoscopy, Direct aryngoscopy, Nasogastric tube placement

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Nasogastric tube (NGT) placement is a basic procedure performed in clinical practice and can be accomplished using a blind technique. However, a blind approach is challenging for many clinicians, including experienced anesthesiologists. Tsai et al[1] reported a failure rate of approximately 50% upon the first attempt using the blind method. Two factors associated with unsuccessful insertion were the soft material property of the NGT and the impaction of the NGT in the periglottic area. The NGT impaction sites reported by Ozer and Benumof[2] were in the piriform sinus in 46% of patients, in the arytenoid cartilage in 25%, and in the trachea in 21%. Although various techniques have been developed to facilitate easier NGT insertion, such as forward displacement of the larynx[3-5], use of a split endotracheal tube[6-8], forward neck flexion[9], and use of a guide wire as a stylet[10],

Correspondence to:

Vijitpavan A.

Department of Anesthesiology, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok 10400, Thailand.

Phone: +66-2-2011552, **Fax**: +66-2-2011569

Email: Fluotec@gmail.com

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this procedure still fails in many cases. Mouth opening with a direct laryngoscope is usually the last method attempted for guiding the tube under visualization when the procedure has been unsuccessful using the blind method. However, limitations of this approach include the limited periglottic view as seen by direct vision and narrowing of the oral space. The videolaryngoscope for tracheal intubation has been introduced to the field of anesthesia and allows for clearer visualization of the pharynx and periglottic anatomy, making it easier to manipulate the tube for passage into the esophagus. Previous literature reported that 2% of the NGTs were malpositioned in the tracheopulmonary system by the blind technique and this problem can be avoided by inserting the NGT under direct vision.

The authors hypothesized that visualization of the periglottic area using a videolaryngoscope (C-MAC D-Blade; Karl Storz, Tuttlingen, Germany) has a higher success rate and lower complication rate than using a direct laryngoscope.

Materials and Methods

Eighty-four patients with indications for NGT insertion and age older than 18 years were enrolled. The exclusion criteria were deformities of the pharynx or larynx, esophageal pathologies, cervical spine instability, and coagulopathies. All patients provided written informed consents in accordance with the requirements of the Ethics Committee at Ramathibodi Hospital, which approved the present study (MURA2014/366). The patients were assigned to the videolaryngoscopy group or direct laryngoscopy group by computer-generated randomization. After induction of anesthesia with 2 mg/kg of propofol or 5 mg/kg of thiopental, intubation was facilitated with a non-depolarizing muscle relaxant (0.6 mg/kg of atracurium or 0.2 mg/kg of cis-atracurium). Anesthesia was maintained with air, oxygen, sevoflurane, and fentanyl. A number 16 NGT was inserted. In the videolaryngoscopy group, the authors used a C-MAC D-Blade videolaryngoscope, which showed the periglottic area on the display monitor, and manipulated the NGT into the esophagus using Magill forceps. In the direct laryngoscopy group, the authors applied the blade of a Macintosh laryngoscope until the periglottic area was seen, the number 16 NGT was then passed using Magill forceps. The optimal length for placement was estimated by measuring the distance from the nostril to the angle of the mandible and from the mandible to the epigastrium. The correct position was confirmed by hearing a gurgling sound at the epigastrium through a stethoscope, this indicated that the procedure was successful. The insertion time was defined as the duration from entrance of the NGT into the nostril to confirmation of its correct position. Manipulation of the NGT out of the nostril and reinsertion was counted as one attempt. Cases involving more than three unsuccessful attempts at NGT placement were classified as failed NGT placement, in such cases, an alternative technique such as the use of a guide wire was applied to assist insertion. Age, gender, body weight, American Society of Anesthesiologists physical status, Mallampati classification, number of attempts, insertion time, and complications were recorded.

Sample size

The authors enrolled 42 patients per group based on the rate of successful NGT insertion at the first attempt according to a previous study[11]. This rate was 85.0% in the videolaryngoscopy group and 57.5% in the direct laryngoscopy group [type I error rate (alpha)=0.05, type II error rate (beta)=0.2].

Statistical analysis

Data were analyzed with PASW Statistics for Windows, version 18.0 (SPSS Inc., Chicago, IL, USA). Fisher's exact test, Pearson's chi-square test, independent sample t-test, and the Mann-Whitney U test were used for statistical analysis. A p-value of less than 0.05 was considered statistically significant.

Results

Eighty-four patients were recruited in the present study. There were no differences in the demographic data or American Society of Anesthesiologists physical status between the videolaryngoscopy group and direct laryngoscopy group. The Mallampati classification and laryngeal views were not different between the two groups and were not associated with the difficulty of NGT insertion (Table 1).

The rate of NGT placement failure was not different between the two groups. However, the videolaryngoscopy group had significantly higher success rate at the first and the second attempts than the direct laryngoscopy group (78.57% versus 30.95% and 92.86% versus 61.9%, respectively; $p<0.001$) (Table 2). The mean time for NGT insertion in the videolaryngoscopy group was significantly shorter than in the direct laryngoscopy group (80 versus 170 seconds, respectively, $p<0.01$). Direct laryngoscopy failed in five cases; however, all

Table 1. Patients' baseline characteristics

	Direct laryngoscopy group (n=42) n (%)	Video laryngoscopy group (n=42) n (%)	p-value
Age (years); mean±SD	57.19±15.76	60.19±11.91	0.328
Sex			0.172
Male	30 (71.43)	24 (57.14)	
Female	12 (28.57)	18 (42.86)	
Body weight (kg); mean±SD	60.41±11.82	61.86±10.53	0.554
Height (cm); mean±SD	163.01±7.52	161.12±7.72	0.258
ASA physical status			0.339
I	1 (2.38)	3 (7.14)	
II	15 (35.71)	9 (21.43)	
III	21 (50.00)	21 (50.00)	
IV	5 (11.90)	9 (21.43)	
Mallampati class			0.625
I	14 (33.33)	10 (23.81)	
II	19 (45.24)	22 (52.38)	
III	9 (21.43)	10 (23.81)	
Laryngeal view			1.000
1	29 (69.05)	30 (71.43)	
2	11 (26.19)	10 (23.81)	
3	2 (4.76)	2 (4.76)	

ASA=American Society of Anesthesiologists; SD=standard deviation

Table 2. Comparison of duration, number of attempts, and failure rate of NGT insertion

	Direct laryngoscopy group (n=42) n (%)	Video laryngoscopy group (n=42) n (%)	p-value
Duration (second); median (IQR)	170 (100 to 250)	80 (56 to 160)	0.001*
Total attempts			<0.001*
1	13 (30.95)	33 (78.57)	
2	13 (30.95)	6 (14.29)	
3	11 (26.19)	1 (2.38)	
>3	5 (11.90)	2 (4.76)	
Success rate in 1st attempt	13 (30.95)	33 (78.57)	<0.001*
Success rate in 2nd attempt	26 (61.90)	39 (92.86)	<0.001*
Success rate in 3rd attempt	37 (88.10)	40 (95.24)	0.523
Procedural failure	5 (11.90)	2 (4.76)	0.523

IQR=interquartile range

* p<0.05 is considered significant

were successful by subsequent videolaryngoscopy. Videolaryngoscopy failed in two cases, but tube insertion was eventually successful by placement of a guide wire in the NGT. Bleeding occurred in 40.48% and 4.76% of patients in the direct laryngoscopy and videolaryngoscopy groups, respectively, and the difference was statistically significant.

Discussion

NGT tube insertion is a basic procedure but

may be difficult, especially in anesthetized and tracheally intubated patients. The authors usually perform this procedure using the blind method, and if unsuccessful, the authors change to application of a direct laryngoscope to the open pharyngeal space, detect the tube position, and pass it through the esophageal inlet. In the present study, the ability to see the periglottic area by mouth opening with a direct laryngoscope was still difficult and had a success rate at the first attempt of only 31% because of limited visualization and narrowing of the space in the oral cavity. Furthermore, it was difficult to manipulate the NGT by passing the Magill forceps into the esophagus while applying the Macintosh laryngoscope, which required a line of sight to see the pharyngolaryngeal structure. Therefore, the success rate at the first attempt in the control group of the present study was relatively lower than that in former studies, in which the failure rate was approximately 50% upon the first attempt using the blind method[1] and 58% by the direct laryngoscopy technique. Thus, Macintosh laryngoscopy-assisted NGT insertion seems to have no advantage over the blind method. In the study group, the authors applied C-MAC D-Blade laryngoscopy as a videolaryngoscopy technique and found that NGT placement had a higher success rate at the first attempt using this method because the periglottic view shown on the display monitor was better than that obtained by directly looking into the narrow space of the pharynx by direct laryngoscopy. This allowed for easier manipulation of the tube. In the present study, the authors investigated C-MAC D-Blade videolaryngoscope that has been routinely used in the authors' hospital in patients with difficult intubation. It could also be applied in patients with difficult NGT insertion. Additionally, there was a reported case supporting to use C-MAC D-Blade videolaryngoscopy for passing the NGT after failure by the blind technique[11]. However, there is no research in this device for NGT placement before.

Many studies of various videolaryngoscopes for NGT insertion, including the GlideScope, King Vision™, and Pentax-AWS system™, showed that these devices can facilitate placement of the NGT[12-19]. The difference between C-MAC D-Blade videolaryngoscope and other videolaryngoscope is the concave-shaped tip of the blade that has the tip angle range from 30 degree to 90 degree. By variation of configurations, each of the videolaryngoscopes should impact differently in the clarity of the periglottic structure and lead to a different difficulty of the NGT insertion. Nevertheless, the present study showed that even different in design of the blade, the C-MAC D-Blade videolaryngoscope can also facilitate NGT placement as those previous studies.

In the present study, the rate of successful NGT insertion at the first and the second attempts were significantly higher in the videolaryngoscopy group (78.57% versus 30.95%, $p<0.001$ and 92.86% versus 61.90%, $p<0.001$, respectively). The procedural failure rate was lower in the videolaryngoscopy group, but not significantly (4.76% versus 11.90%, $p=0.523$), whereas the operators in the control group required more time and more repeated attempts to successfully perform the procedure.

Five cases using the Macintosh laryngoscope failed, but success was achieved by videolaryngoscopy. This suggested superiority of videolaryngoscopy over the direct laryngoscopic method and is in agreement with a study by Dharmalingam and Gunasekaran[11], who reported successful NGT placement by C-MAC D-Blade videolaryngoscopy after failed placement of the NGT in the intensive care unit using the blind and direct laryngoscopy methods. In the present study, two cases using the videolaryngoscope failed even after the tip of the tube had already passed into the upper esophagus. This was because the soft NGT kinked and coiled during insertion. The authors corrected both of these problems by placing a guide wire into the tube and successfully reinserting it by videolaryngoscopy. Kirtania et al[10] and Appukutty and Shroff[20] used a guide wire to decrease the flexibility of the NGT and found that the success rate of insertion increased. In the present study, the causes of NGT placement failure were the impact of the tip of the NGT in the periglottic area and the soft material property of the NGT. These findings correspond to those of the study by Ozer and Benumof[2], who reported that the NGT impact sites were the piriform sinus in 46% of patients, arytenoid cartilage in 25%, and tracheal cuff in 21%. Although the videolaryngoscope helped to elucidate the periglottic anatomy, the pliable nature of the NGT also played a role in achieving success of this procedure[21]. In the present study, there was no difference in the Mallampati classification and laryngeal view grading between the control and study groups. A high Mallampati classification and laryngeal view grading might affect the success of NGT placement, but the authors did not investigate the relationship between the Mallampati classification and the success of NGT insertion. The incidence of bleeding complications was lower in the videolaryngoscopy group, which was probably related to the less time required to perform the procedure and the lower number of

attempts. Rassias et al[22] and Pallai et al[23] reported the incidence of malpositioning of the feeding tube in the tracheopulmonary system in 2% of the patients. However, because the authors were able to see the periglottic anatomy by both techniques, no inadvertent tracheopulmonary insertion occurred in the present study. The overall success rate by Macintosh direct laryngoscopy in the present study was not different from the blind method reported in other studies, therefore, if NGT placement was unsuccessful, the case should be converted to videolaryngoscopy.

The findings of the present study supported the notion that visualization by C-MAC D-Blade videolaryngoscopy can be used as a rescue technique of choice in case of failure NGT insertion by the blind or conventional direct laryngoscopic approach, and that videolaryngoscopy can even be applied as a primary approach for NGT placement to achieve a shorter insertion time, a higher success rate, and fewer complications. Moreover, the success of NGT insertion depends not only on visualization of periglottic area but also on the rigidity of the NGT. Therefore, strengthening of the tube by a guidewire make the procedure easier.

The present study has some limitations. First, the authors could not blind the operators in the two groups, which may have biased the results. Second, failure of NGT insertion may have been caused by difficulty in advancing the tube from the esophagus into the stomach, and the failed attempts in this step were unrelated to viewing of the periglottic anatomy by both laryngoscopes. Therefore, the study outcomes may be confounded and cannot be used to indicate the real efficacy of each device. Finally, although auscultation is not completely reliable[24], the authors still used it with air insufflation to confirm the NGT position, because it is easy to perform and is used as a routine method in the operating room. The authors were able to rule out false-positive NGT placement in the tracheopulmonary system by auscultation because both methods were performed under visualization. However, malpositioning of the NGT in the distal esophagus may still occur and cannot be detected by auscultation.

Conclusion

Videolaryngoscopy is easier and faster for NGT placement and is associated with a lower incidence of bleeding complications and a higher success rate. Therefore, this method should be considered as an alternative option when encountering difficulty inserting the NGT using the conventional technique.

What is already known on this topic?

Two factors associated with unsuccessful insertion in intubated patients were the soft material property of the NGT and the impaction of the NGT in the periglottic area.

Application of a direct laryngoscope to open pharyngeal space and to detect the NGT position had a success rate at the first attempt of only 31% because of limited visualization of the space in the oral cavity.

What this study adds?

Visualization of periglottic area by video-laryngoscopy can be used as a rescue technique of choice for NGT placement, especially when combined with a guidewire in cases of failure by the blind or direct laryngoscopic approach, or even be applied as a primary approach for NGT placement to achieve a shorter insertion time, a higher success rate, and fewer complications.

Disclosure

The preliminary data of the present study were presented as an abstract entitled "Videolaryngoscope Compared to Direct Laryngoscope for Nasogastric Placement" in the Thai Journal of Anesthesiology, Vol. 41, 2015, p. 141-2.

Authors' contributions

Vijitpavan A designed the study and critically revised the final draft of the manuscript. Ruananukun N collected and analyzed the data and helped to prepare the manuscript. Chaiboon P collected and analyzed the data. All authors read and approved the final version of the manuscript.

Conflicts of interest

The authors declare no conflict of interest regarding the publication of this article.

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