SCIENTIFIC ARTICLE

Comparing insertion characteristics on nasogastric tube placement by using GlideScope™ visualization vs. MacIntosh laryngoscope assistance in anaesthetized and intubated patients

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Abstract
Background and objective: This was a prospective, randomized clinical study to compare the success rate of nasogastric tube insertion by using GlideScope™ visualization versus direct MacIntosh laryngoscope assistance in anesthetized and intubated patients.
Methods: Ninety-six ASA I or II patients, aged 18–70 years were recruited and randomized into two groups using either technique. The time taken from insertion of the nasogastric tube from the nostril until the calculated length of tube had been inserted was recorded. The success rate of nasogastric tube insertion was evaluated in terms of successful insertion in the first attempt. Complications associated with the insertion techniques were recorded.
Results: The results showed success rates of 74.5% in the GlideScope™ Group as compared to 58.3% in the MacIntosh Group ($p = 0.10$). For the failed attempts, the nasogastric tube was successfully inserted in all cases using rescue techniques. The duration taken in the first attempt for both techniques was not statistically significant; Group A was 17.2 ± 9.3 s as compared to Group B, with a duration of 18.9 ± 13.0 s ($p = 0.57$). A total of 33 patients developed complications during insertion of the nasogastric tube, 39.4% in Group A and 60.6% in Group B ($p = 0.15$). The most common complications, which occurred, were coiling, followed by bleeding and kinking.
Conclusion: This study showed that using the GlideScope™ to facilitate nasogastric tube insertion was comparable to the use of the MacIntosh laryngoscope in terms of successful rate of insertion and complications.
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Comparação das características de inserção de sonda nasogástrica, usando visibilização pelo laringoscópio GlideScope® vs. guiada pelo laringoscópio MacIntosh em pacientes anestesiados e intubados

Resumo
Justificativa e objetivo: Este foi um estudo clínico prospectivo e randômico para comparar a taxa de sucesso da inserção de sonda nasogástrica (NG) usando as técnicas de visibilização pelo GlideScope® versus guiada pelo laringoscópio MacIntosh em pacientes anestesiados e intubados.
Métodos: Foram recrutados 96 pacientes, ASA I ou II, entre 18-70 anos, e divididos randomicamente em dois grupos, com uma ou outra técnica. Foi calculado o tempo transcorrido desde a inserção da sonda NG, da narina até a inserção do comprimento calculado da sonda. A taxa de sucesso de inserção da sonda NG foi avaliada quanto à inserção bem-sucedida na primeira tentativa. As complicações associadas às técnicas de inserção foram registradas.
Resultados: Os resultados mostraram taxas de sucesso de 74,5% para o grupo GlideScope®, me comparação com 58,3% para o grupo MacIntosh (*p* = 0,10). Para as tentativas que falharam, a sonda NG foi inserida com sucesso em todos os casos, usando as técnicas de resgate. A duração da primeira tentativa para ambas as técnicas não foi estatisticamente significativa: 17,2 ± 9,3 segundos no Grupo A e 18,9 ± 13,0 segundos no Grupo B (*p* = 0,57). No total, 33 pacientes desenvolveram complicações durante a inserção da sonda NG: 39,4% no Grupo A e 60,6% no Grupo B (*p* = 0,15). As complicações mais comuns ocorridas foram enrolamento, seguido de sangramento e dobradura.
Conclusão: Este estudo mostrou que o uso do GlideScope® para facilitar a inserção de sonda nasogástrica foi comparável ao uso do laringoscópio MacIntosh quanto à taxa de sucesso de inserção e complicações.

Introduction

Even for the most experienced anesthesiologist, the insertion of a nasogastric (NG) tube in anesthetized and tracheally intubated patients can be very challenging.[1] The usual method of insertion is by 'blindly' inserting the NG tube with the patient's head in a neutral position, whereby success rates have been reported to vary from 40% to 58%.[2–4] Various techniques of NG tube insertion have been described, emphasizing the fact that as yet, there is no easy, simple and safe method.[5] Common methods used to facilitate NG tube insertion include the use of a 'slit' endotracheal tube as an introducer, forward displacement of the larynx, use of a ureteral guide wire as a stylet, head flexion, lateral neck pressure, placing the patient's head in the lateral position, freezing the NG tube with distilled water and the use of a gloved finger to steer the NG tube after impaction.[2–4,6] It also has been suggested that deflating the endotracheal tube (ETT) cuff will decrease esophageal compression and therefore facilitate insertion of the NG tube.[1] However, none of these techniques have been reported to be universally successful.

In addition to these maneuvers, the use of visualization-aided modalities has also been advocated to facilitate NG tube insertion. The GlideScope™ videolaryngoscope is a reusable device that consists of a handle and a blade. Although the handle is similar to that of a standard laryngoscope, the blade is different because it is not detachable, has a maximum width of 26 mm at any point, and has a 60° curvature in the midline. It includes an integrated CMOS camera; an LED light source, a patented antifogging mechanism and reusable, medical-grade robust plastic shell. The image captured by the camera is displayed on a 7-in. liquid crystal display color monitor. Although acknowledged as an effective device used for tracheal intubation,[7,8] there are few studies done to assess the effectiveness of the GlideScope™ in facilitating NG tube insertion and only a few reports mentioning its usefulness in doing so.[5,9,10] The GlideScope™ also has been reported to aid in the insertion of a transesophageal echocardiography probe when all other placement methods have failed.[11]

Studies have shown that the GlideScope™ provides an improved view of the larynx as compared to direct laryngoscopy.[7,8] Oesophageal opening visualization by using the MacIntosh laryngoscope is also not optimum as compared to the use of the GlideScope™. Hence, insertion of the NG tube under direct vision using a videolaryngoscope may provide real-time view, should help improve speed of insertion and potentially reduce complications.

A study by Moharari et al.[1] showed that the GlideScope™ could be a safe and effective aid for NG tube insertion in anesthetized and intubated patients by improving the ease of insertion with a success rate of 85%. However, the study compared the conventional 'blind technique' versus GlideScope™ assistance, which provides a direct view during insertion. The objectives of this study were to compare

insertion characteristics on nasogastric tube placement by using GlideScope™ visualization versus MacIntosh laryngoscope assistance with regards to first successful attempt, rescue attempts and complications in anesthetized and intubated patients.

Materials and methods

This prospective, randomized, single-blinded clinical study was conducted after obtaining institutional ethics approval from the Medical Research and Ethics Committee, Universiti Kebangsaan Malaysia Medical Centre (UKMMC) (Project code: FF-199-2012) and the Clinical Research Committee of Ministry of Health Malaysia (NMRR-12-1010-12540). After obtaining written informed consent, a total of 96 American Society of Anesthesiologists (ASA) I or II patients aged between 18 and 70 years, scheduled for surgery under general anesthesia requiring tracheal intubation and NG tube insertion were recruited into this study. Those excluded from the study were patients with known basal skull fracture, hemorrhagic disorders, esophageal diseases such as stricture, varices or stenosis, history of radiotherapy to the head and neck and obesity with a body mass index (BMI) of more than 35 kg/m^2. Preoperatively, patients were randomized using computer-generated randomized numbers into two groups. The more patent nostril was selected based on two criteria, the amount of fogging produced on a metal tongue depressor during exhalation and the relative size of the nostril. The nostril that was bigger and produced more fog was chosen. All patients were premedicated with oral midazolam 7.5 mg on the night before surgery.

Intravenous access (IV) was established in the operating theater. Standard monitoring with continuous electrocardiography, non-invasive blood pressure monitoring, pulse oximetry and capnograph were used for all patients. Following preoxygenation, induction of anesthesia was carried out using IV propofol 2 mg/kg, IV fentanyl 2 mcg/kg and IV rocuronium 0.9 mg/kg. Patients were given assisted ventilation via facemask for 3 min following which direct laryngoscopy performed. The patients were intubated with a size 7.5 mm (for female) or 8.0 mm (for male) internal diameter, polyvinyl chloride endotracheal tube (ETT). The ETT cuff was inflated and the pressure kept between 15 and 25 cm H_2O using a pressure gauge manometer. Anesthesia was maintained by oxygen/air (50%/50%) and sevoflurane at a minimum alveolar concentration of 1.

Multiple operators consisting of anesthesia medical officers, who were proficient in both techniques, were responsible for the NG tube insertions. In Group A patients, the blade of the GlideScope™ was inserted into the patient's mouth, the tracheal tube and tongue were lifted to provide the anesthetist with the best view of the laryngeal area which was visualized on the display color monitor and the NG tube was advanced. In Group B patients, the blade of the MacIntosh laryngoscope was inserted into the patient's mouth, the tracheal tube and tongue were lifted to provide the anesthetist with the best view of the laryngeal area, visualized orally and the NG tube was advanced. In both groups, the patient's head was maintained in the neutral position and the blades were lifted gently to prevent excessive extension of the neck.

In all patient groups, a 14 French gauge (FG), 125 cm NG tube (Foresight Industries Sdn Bhd, Selangor, Malaysia) with lead was used. The length of NG tube necessary to reach the stomach was assessed before insertion and measured by placing the tip of the NG tube on the patient's xiphoid process and extending it to the tip of his/her nose and over the earlobe. Immediately before insertion, KY jelly was applied on the selected patient's nostril. In each group, the NG tube was passed via the patient's nostril posteriorly along the floor of the nose and tube was advanced to reach the measured length. A successful NG tube insertion was defined as the successful passage of the NG tube in the first attempt and confirmed when the tube passed smoothly and a gurgling sound was heard on auscultation over the epigastrium when injecting 10 mL of air through the NG tube. In the first attempt, no assisting device was used in both groups. If the NG tube was not successfully inserted, it was deemed as a procedural failure and recorded as a failed attempt. The NG tube was withdrawn fully and cleaned. Subsequently rescue techniques were implemented to insert the NG tube until it was successfully inserted. Rescue techniques comprised of second attempt and switch-over technique. The same NG tube was used in the second attempt, this time with the assistance of a Magill's forceps. If that too failed, the NG tube was reinserted switching over the 2 techniques while using the assistance of a Magill's forceps. In Group A, the MacIntosh laryngoscope was used and in Group B, the GlideScope™ was used instead to insert the NG tube (refer to Fig. 1 for the study flow chart).
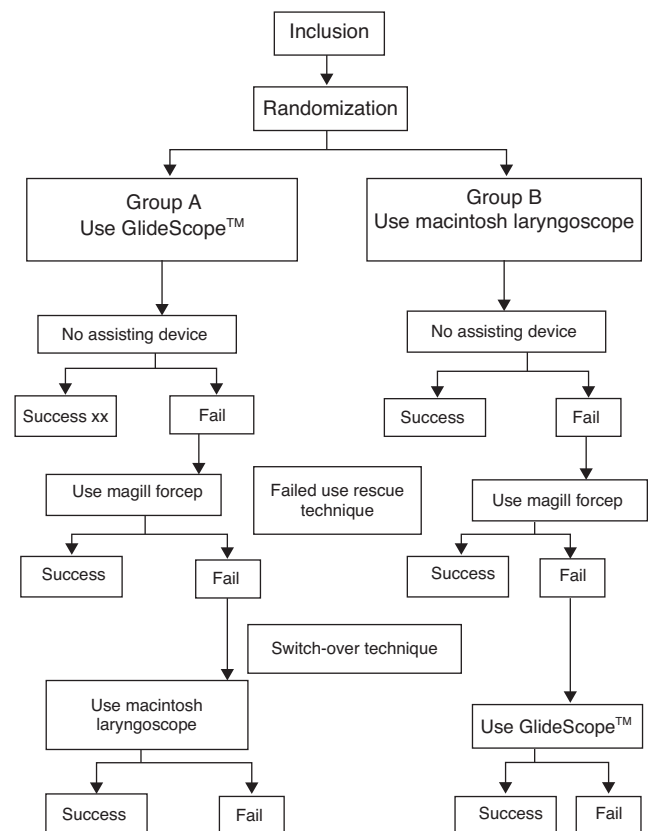

Figure 1 Study flow chart.

The duration required for placement was taken from the time when the tube was advanced into the nostril until the measured length of the tube had been inserted. A general anesthesia assistant measured the time taken using stopwatch. The occurrence of complications such as bleeding, kinking and coiling during the procedure was noted. The rate of successful NG tube insertion and the duration needed for successful insertion on the first attempt was compared between the 2 groups.

All data were recorded and analyzed using SPSS version 21.0 software. Normal distribution of continuous data was tested by the Kolmogorov–Smirnov test. Non-parametric data (gender, race, ASA, intubation attempt and complications) were analyzed using the Chi-square test. Independent T-test was used to analyze parametric data (age, height, weight, BMI and duration of insertion). A p-value of less than 0.05 was considered to be statistically significant.

Results

A total of 96 patients were enrolled but only 95 patients were included, as one patient from Group A, who initially consented to participate in the study, refused surgery on the day of operation. Forty-seven patients were enrolled in Group A and 48 patients in Group B. The demographic data is shown in Table 1. The demographic data was comparable between both groups.

Table 2 shows successful insertions of the NG tube during the first attempt and rescue techniques. The NG tube was ultimately inserted in all patients.

The mean time for duration of insertion in the first attempt for Group A was 17.2 ± 9.3 s and for Group B

was 18.9 ± 13.0 s ($p = 0.57$). Thirty-three patients developed complications during insertion of the NG tube, 13 patients (39.4%) in Group A and 20 patients (60.6%) in Group B ($p = 0.15$).

The complications were further categorized to coiling, kinking and bleeding. Eleven patients (23.4%) in Group A and 17 patients (35.4%) in Group B developed coiling ($p = 1.00$). Bleeding occurred in 4 patients (8.5%) in Group A and 5 patients (10.4%) in Group B ($p = 1.00$). Kinking occurred in 2 patients (4.3%) in Group A and 1 patient (2.1%) in Group B ($p = 0.55$). One patient in Group A had accidental malposition of the NG tube into the trachea. Percentage of complications that was calculated reflects the occurrence of complications in all attempts collectively. One patient may also have had more than one complication occurring during the insertion procedure.

Discussion

Our study was designed to compare direct visualization techniques using two different intubation devices to assist in nasogastric tube insertion. We found that there appeared to be a higher success rate in Group A compared to Group B, 74.5% vs. 58.3%, although this was not statistically significant. A larger sample size would most probably be required to look for a significant statistical difference in the success rate of insertion.

Our study showed that there was no significant difference in the duration of insertion between these 2 groups. A study done by Moharari et al.[1] showed a shorter duration of insertion in the GlideScope™ group (10.9 ± 9.0 s) as compared to the 'blind' insertion technique group (38.6 ± 29.0 s). A few previous studies comparing the conventional 'blind' technique and various other techniques of insertion showed that the duration of NG tube insertion using the 'blind' technique took between 39.5 s and 124 s for successful insertion.[2,4,12] Hence, direct visualization techniques may improve NG tube insertion speed. In future studies however, it would perhaps be better to include a 'blind' technique group to allow better comparison between new techniques of insertion with the conventional method, to assess speed of NG tube insertion.

However, in the rescue second attempt, there were a higher percentage of patients in Group B who had successful insertion of the NG tube although this was not statistically significant. This can be explained by the difficulty in manipulating the Magill's forceps in Group A patients due to the bulkiness of the GlideScope™ blade allowing limited space to move the Magill's forceps orally as compared to the use of the MacIntosh blade.

The most common complication in this study was coiling. Eleven patients (23.4%) in Group A and 17 patients (35.4%) in Group B developed coiling. The piriform sinuses and the arytenoid cartilages are the most common sites of impaction of a NG tube during insertion.[2] It has been suggested that compression of the ipsilateral neck at the level and lateral border of the thyrohyoid membrane can be performed to collapse the ipsilateral piriform fossa and slightly move the arytenoids cartilage so that NG tube can pass through via the lateral or posterior hypopharynx.[13] Other recommendations made to overcome the site of impaction were, neck

Table 1 Demographic data, values expressed as mean $\pm$ SD or number n (%) where appropriate.

	Group A (n = 47)	Group B (n = 48)	p-Value
Age (years)	51.7 ± 13.3	47.0 ± 14.2	0.11
Gender			0.35
Male	18 (38.3)	14 (29.2)	
Female	29 (61.7)	34 (70.8)	
ASA			0.47
I	20 (42.6)	25 (52.1)	
II	27 (57.4)	23 (47.9)	
Weight (kg)	65.1 ± 9.7	63.3 ± 13.9	0.47
Height (m)	1.6 ± 0.7	1.6 ± 0.8	0.76
BMI (kg/m^2)	25.4 ± 3.6	24.9 ± 4.6	0.54

Table 2 Success rates of NG tube insertion, values expressed as number n (%).

Attempts	Group A (n = 47)	Group B (n = 48)	p-Value
1st attempt	35 (74.5)	28 (58.3)	0.10
Second attempt	11 (23.4)	18 (37.5)	0.55
Switch-over	1 (2.1)	2 (4.2)	1.00

flexion with lateral pressure (82% success rate in the first attempt),[2] using neck flexion (80% success rate in the first attempt),[3] head turned to the lateral position (80% success rate in the first attempt),[5] and lifting the thyroid cartilage (68.8% success rate in the first attempt).[14] However, for patients with cervical instability, these techniques cannot be used. Agro et al.[15] demonstrated that the GlideScope™ provided a better vision of the glottis compared to the MacIntosh laryngoscope in cervical spine immobilization. In another study, Malik et al.[12] also showed that although the GlideScope™ required more time for tracheal intubation, it reduced intubation difficulty and improved glottic view over the MacIntosh laryngoscope in patients with cervical spine immobilization. Thus using the GlideScope™ for NG tube insertion would also be beneficial in cases where manipulation of the neck is limited.

Another complication observed was bleeding from mucosal surface. However, there was no statistical difference in both groups. None of these patients needed further medical treatment. It was observed that the bleeding was mostly from the nostril and nasopharynx area and probably occurred due to trauma from the tip of NG tube during insertion rather than trauma caused from the various techniques itself. In order to lessen the occurrence of bleeding, some studies prepared the patient's nostril with vasoconstrictors (such as phenylephrine or oxymetazoline) prior to NG tube insertion.[1,3] In our study, we did not use any vasoconstrictors to prepare the patient's nostril. Appukutty and Shroff[2] used a slit ETT orally to assist in insertion of the NG tube and reported a high success rate in the first insertion attempt using this technique. However, there was increased risk of bleeding (22%) with this technique as compared to other techniques used in the study.

Although NG tube insertion is considered a common clinical procedure, it can produce unexpected complications. In our study, there was an inadvertent, accidental placement of the NG tube into the trachea of one patient in Group A. This was evidenced by bubbling of water when the proximal tip of the NG tube was immersed in a gallipot of water. The NG tube was however, successfully inserted using the rescue technique. Rassias et al.[16] reported a 2% incidence of tracheopulmonary complications such as pneumothorax, hydrothorax or hemorrhage among 740 NG tube insertions whereby 0.3% of patients died from these complications. Pillai et al.[17] suggested that the presence of the ETT might actually increase the risk of pulmonary entry of the NG tube due to prevention of glottic closure. A preexisting ETT may distort the anatomy of the laryngeal opening due to the presence of the ETT cuff expanding the glottic opening leading to an increased risk of nasoenteral tube malposition and complications.[17] The technique of deflating ETT cuff before insertion of the NG tube would be helpful in increasing the success rate of insertion as shown in studies by Moharari et al.[1] and Lai et al.[5] although by doing so, may lead to the potential risk of aspiration when the ETT cuff is deflated. However, none of these studies reported aspiration as one of the complications.

The use of the MacIntosh laryngoscope with assistance of the Magill forceps is the conventional rescue technique in the institution where this study was carried out. This technique also has been used as the rescue technique in most of the studies involving NG tube insertion.[1–3,14] However, the GlideScope™ assistance technique may be used as the rescue technique of choice when other methods have failed as evidenced by the high success rate of insertion using the GlideScope™ as shown in the study by Moharari et al.[1] and other previous case reports.[5,9,10]

There were a few limitations in this study. Firstly, the potential for investigator bias exist as it is impossible to blind the anesthetists to the device being used. Furthermore, multiple operators were involved in inserting NG tube. Therefore, there will also be skill bias in this study. A study by Matheison[18] which included attending anesthesiologists, anesthesiologist fellows and respiratory therapists showed that after 30 intubation attempts using the GlideScope™, success rates of intubation were high (94.2%). Therefore, to reduce skill bias in future studies; it can be recommended that at least 30 previous NG tube insertions using the GlideScope™ by the investigators would be required to gain expertise with its use.

The GlideScope™ has been used widely in difficult intubation cases. However for ethical reasons, cases of difficult NG tube insertion due to difficult airways and obese patients were excluded from this study. Therefore, results in our study would not reflect the outcome in these groups of patients. The advantage of using the GlideScope™ compared to using the MacIntosh blade is that it does not require a line-of-sight view from the operator to the esophageal opening. As it has been shown to be advantageous in difficult airway situations, further studies using the GlideScope™ may be recommended to facilitate NG tube insertion in obese patients and those with potential difficult airways and cervical instability. In conclusion, this study showed that using the GlideScope™ to facilitate nasogastric tube insertion was comparable to the use of the MacIntosh laryngoscope in terms of successful rate of insertion and complications.

Conflicts of interest

The authors declare no conflicts of interest.

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