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Research paper

A comparison of the video laryngoscopes with Macintosh laryngoscope for nasotracheal intubation

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ABSTRACT

Nasotracheal intubation (NTI) is usually required in patients undergoing maxillofacial surgery. Though video-scopes have been demonstrated to perform well in oral endotracheal intubation, limited information is available concerning NTI. The aim of the study is to compare the efficiency of video-scopes and the traditional direct laryngoscopy in NTI. One hundred and eight patients scheduled for elective oro-maxillofacial surgery under nasotracheal intubation general anesthesia were randomly allocated into one of 3 groups of GlideScope, Pentax AirWay Scope, or Macintosh laryngoscope respectively. The primary outcome measures were total intubation time and each separate time interval (time A: for placement for the nasotracheal tube from selected nostril to oropharynx; time B: for use of devices to view the glottic opening; time C: for advancing nasotracheal tube from oropharynx into trachea and removing the scope from the oral cavity). The secondary outcomes were measurement of scores of modified naso-intubation difficulty scale (MNIDS) and attempts at intubation.

Results: Mean total intubation time and time C interval were taken with GlideScope (33.1 s and 9.7 s), Pentax (38.4 s and 12.9 s), and Macintosh (42.2 s and 14.9 s) respectively. There was a significant difference among the groups (total time, $P = 0.03$; time C, $P = 0.02$). The median score of MNIDS was significantly lower using GlideScope or Pentax compared with using Macintosh in NTI ($P = 0.037$) and difficult intubation grading by MNIDS presented as easier in the GlideScope group than in the Macintosh group (0.016). Using GlideScope, intubation was successful at the first attempt in 80% patients whereas only 65% and 72.5% with the Pentax and Macintosh ($P = 0.02$).

Conclusion: As compared with the Macintosh laryngoscope, the GlideScope video laryngoscope facilitated nasotracheal intubations with shortened intubation time and reduced intubation difficulty in patients undergoing oromaxillofacial surgery.

1. Introduction

Nasotracheal intubation (NTI) is commonly practiced in patients undergoing oro-maxillofacial surgery to provide a secure airway and good operation field. Using Macintosh laryngoscope (ML) to facilitate NTI is a conventional direct laryngoscope technique. However, new video laryngoscope devices allowing viewing indirectly through video display equipped with the blade tip camera such as GlideScope (Verathon, Bothell, WA, USA) and the Pentax Airway Scope (Pentax AWS; Pentax, Tokyo, Japan) for intubation have been demonstrated to improve intraoral field exposure and increase efficiency in glottic visualization for both normal and difficult airway management.[1–5]

The GlideScope, with a fixed steep 60-degree angulation blade, often needs to use a GLiderite® rigid stylet to enable a quick endotracheal intubation.[3] However, it is not allowable to use this rigid stylet while the double-curve endotracheal tube is passing through the nasal cavity. Using Pentax AWS to assist oro-tracheal intubation, the blade should be attached, endotracheal tube lubricated, and loaded into the tube channel aside the blade. The blade is then placed beneath the epiglottis to visualize the glottis.[6] However, the designed blade is not recommended for double-curve

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endotracheal tube placement also, due to the indirect laryngoscopy only requiring alignment of the pharyngeal and laryngeal axes.[1,7] Both devices have been reported to be more effective than the Macintosh laryngoscope for orotracheal intubation.[1,4,8–12] However, there is limited information concerning the efficiency of indirect laryngoscopy in double-curve nasotracheal intubation.[7,13] The purpose of this randomized, single-blinded study was to evaluate the efficiency of the two video laryngoscopes: the GlideScope and the Pentax AWS, vis-à-vis the Macintosh laryngoscope for elective NTI in patients undergoing oro-maxillofacial surgery.

2. Methods

After approval from the local Institutional Review Board (IRB No. KMUH-IRB-990188) and approval for clinical trial investigation (NCT02448277), written informed consent was obtained from each patient enrolled. A total of 108 patients classified as American Society of Anesthesiologist physical status I or II, aged 20–65 years, who were undergoing elective oro-maxillofacial surgery were included in the study. Patients with a limited mouth opening of less than 3 cm, a history of documented difficult tracheal intubation, cervical spine instability, chronic suppurative sinusitis, and contraindications to NTI were excluded.

All patients received pre-anesthesia airway evaluation before entering the operation room, and their inter-incisor distance, thyromental distance and Mallampati classification were measured and recorded. The patients were allocated randomly into three groups as follows: 108 index cards were placed in 108 envelopes, and 36 cards were marked with the code for each airway device including GlideScope, Pentax AWS and direct Macintosh laryngoscopes in the randomized, clinical, controlled study. Code A represented GlideScope, code B represented Pentax AWS, and code C represented Macintosh laryngoscope. Each patient selected an envelope after entering the operation room for airway device.

All patients were blinded to the chosen device. Nasotracheal intubations were performed by an experienced anesthesiologist using GlideScope® video-laryngoscope (Verathon Inc., Bothell, WA, USA), Pentax Airway Scope (AWS; Pentax Corporation, Tokyo, Japan) or Macintosh laryngoscope. Each patient was asked to fast for at least 8 h and was given no premedication prior to surgery. On arrival at the operating room (OR), patients were monitored with heart rate (HR), lead II electrocardiography (ECG), and noninvasive blood pressure (BP). The selected nostril was sprayed with 6% cocaine by an intranasal mucosal atomization device (Wolfe Troy Medical, Inc. Salt Lake City, Utah, USA). Anesthesia was induced with fentanyl 2 mcg/kg, thiamylal 5 mg/kg, and cis-atracurium 0.2 mg/kg to facilitate NTI. Patients were manually ventilated with 60% oxygen for three minutes following loss-of-eyelash reflex. A 22-gauge catheter was inserted into the radial artery following loss of consciousness for continuous blood pressure measurement. Propofol 1 mg/kg was given prior to intubation to blunt intubation-related hemodynamic responses. A preformed double-curved endotracheal tube of high-volume low-pressure cuff with Murphy eye tip (Unomedical Sdn. PharmaPlast, Kedah, Malaysia) was used in all patients (7 mm ID for men and 6.5 mm ID for women). Inhaled sevoflurane was administered to maintain end-tidal concentration at 2.5–3.5% and end-tidal CO2 (ETCO2) concentration within the range of 35–40 mmHg.

An independent nurse anesthetist recorded all data in each one of these trials. The primary outcomes were evaluated by total intubation time and each time interval (time A: placement of the nasotracheal tube from selected nostril to oropharynx; time B: use of devices to view the glottic opening; time C: nasotracheal tube advanced from oropharynx into trachea and removal of the scope form oral cavity). The secondary outcomes were scores of modified naso-intubation difficulty scale (MNIDS) developed by Adnet and colleagues and attempts of intubation.[14] The MNIDS scored intubation conditions were assessed as follows: N1, additional intubation attempts; N2, number of supplementary operators, directly but not assisted; N3, alternative intubation techniques such as change of head position or cuff inflation intervention; N4, glottic exposure grading as Cormack–Lehane minus 1; N5, lifting force; N6, glottic exposure with BURP maneuver; N7, vocal cords position.[15] The MNIDS scores were categorized as easy (0), minor difficulty ($0 \leq$ scores ≤ 5), major difficulty ($5 <$ scores). Hemodynamic responses (heart rate and mean arterial pressure changes) were measured at each time point of cocaine spray, peri-intubation period, and NTI-related side-effects were also compared. Other parameters assessed in relation to anesthesia included: nasal bleeding, inflated cuff, backward upward rightward pressure (BURP) maneuver and postoperative adverse events (sore throat, hoarseness, dysphagia).

In this study, the expected difference of mean total intubation time between groups was 10 s and of the common within group deviation was 12 s. At least 33 patients were needed in each group with set power of 0.8 and significance level of 0.05. We enrolled patients' number to 36 in each group to allow for unexpected patient withdrawal and attrition. Group differences in intubation-related time taken were compared by ANOVA followed by Scheffe test of multiple post hoc analyses. Numerical variables are given as mean or unexpected patient withdrawal and attrition. Group differences in intubation-related time taken were compared by ANOVA followed by Scheffe test of mu the $\chi 2$ test. SPSS 17.0 software (SPSS Inc., Chicago, IL, USA) was used for all statistical analyses. A P value < 0.05 was considered statistically significant.

3. Results

The demographic data (age, body mass index, and gender difference) and airway data (inter-incisor width, thyromental distance, and Mallampati classification) are shown in Tables 1 and 2. There was no significant difference between the three groups. Three patients in the Pentax group were excluded from this study as one suffered from acute URI attack, one failed to have the tube inserted through the nasal cavity, and one patient exhibited limited mouth opening even after induction agents were given (Fig. 1).

The mean total and each separate time C spent were calculated as 32.9 s and 9.9 s in the GlideScope group, 38.4 s and 12.9 s in the Pentax group, and 42.7 s and 8.5 s in the Macintosh group respectively (Table 3). Both total intubation time and time C interval

Table 1
Demographic data. Value are shown as mean ± SD, Age item is presented as median with 95% confidence interval [CI 95%].

	GlideScope ($n = 36$)	Pentax ($n = 33$)	Macintosh ($n = 36$)	P value
Age (y/o)	44 (39.8–48.8)	40.9 (35.5–46.3)	43.6 (38.9–48.2)	0.574
Gender				
Male	18 (50%)	22 (66.7%)	22 (61.1%)	0.411
Female	18 (50%)	11 (33.3%)	14 (38.9%)	
Body mass index (BMI)	24.7 ± 4.3	22.8 ± 3.2	24.8 ± 4.3	0.075

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