

Rigid Laryngoscope-assisted Insertion of Transesophageal Echocardiography Probe Reduces Oropharyngeal Mucosal Injury in Anesthetized Patients

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Background: Intraoperative transesophageal echocardiography has become a routine part of monitoring in patients with cardiac disease. However, insertion of a transesophageal echocardiography probe can be associated with oropharyngeal, esophageal, and gastric injuries. The purpose of this study was to determine whether insertion of a transesophageal echocardiography probe under direct laryngoscopic visualization can reduce the incidence of oropharyngeal mucosal injury.

Methods: Eighty patients undergoing surgery with general anesthesia were randomly allocated to either the conventional group, in which the probe was inserted blindly, or the laryngoscope group, in which a rigid laryngoscope was used to visualize the passage of the probe. The incidence of oropharyngeal mucosal injury, the number of insertion attempts, and odynophagia were assessed.

Results: There was no significant difference in demographic and hemodynamic parameters between the 2 groups. The incidence of oropharyngeal mucosal injury was higher in the conventional group than in the laryngoscope group (55% vs. 5%, $P < 0.05$). The incidence of odynophagia was higher in the conventional group than in the laryngoscope group (32.5% vs. 2.5%, $P < 0.05$). The number of insertion attempts was also higher in the conventional group than in the laryngoscope group.

Conclusion: Rigid laryngoscope-assisted insertion of the transesophageal echocardiography probe reduces the incidence of oropharyngeal mucosal injury, odynophagia, and the number of insertion attempts.

TRANSESOPHAGEAL echocardiography (TEE) has expanded its scope into the field of anesthesia because of its ability to evaluate anatomical and functional disorders of the heart at any given time. In addition, it is less invasive as compared with other diagnostic procedures, thereby facilitating its widespread use in the operating room, as well as in other critical care settings.

Intraoperative TEE has been reported to be a relatively safe diagnostic monitor, because the incidence of severe complications such as upper digestive tract perforation is very low.^{1–6} However, blind insertion of the TEE probe in anesthetized patients may be difficult because

of the loss of upper airway muscle tone and the presence of an endotracheal tube. The tip of the TEE probe may cause minor injuries to the oropharyngeal mucosa, which may result in oropharyngeal pain and odynophagia after the surgery.

We experienced quite a few oropharyngeal injuries after TEE examination, even if the probe was inserted without difficulty. Since the use of a rigid laryngoscope has been reported to facilitate the insertion of the TEE probe when blind insertion has failed,^{3,5} we hypothesized that routine application of the laryngoscope-assisted technique would decrease the incidence of oropharyngeal injury after TEE examination. Therefore, this study was designed to compare the incidence of oropharyngeal injury during TEE probe insertion between the conventional and laryngoscope-assisted techniques.

Materials and Methods

This study was approved by the Yonsei University Review Board (Seoul, Korea), and written informed consent was obtained from all patients. Eighty-six women between 20 and 55 years of age, with American Society of Anesthesiologists physical Status I or II, scheduled for elective gynecologic surgery under general anesthesia were included. Patients with sore throat, oropharyngeal infection, or neck pain were excluded.

Patients were premedicated with midazolam (0.05 mg/kg, IV) 30 min before surgery. General anesthesia was induced with remifentanyl (0.2 $\mu\text{g/kg}$, IV) and propofol (1.5 mg/kg, IV). The trachea was intubated orally after administration of rocuronium (0.6 mg/kg, IV). Anesthesia was maintained with sevoflurane (0.5–1.5 Vol%) in 50% $\text{O}_2/\text{N}_2\text{O}$ and remifentanyl (0.1 $\mu\text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$). After excluding 4 patients who sustained injury during intubation with a Bonfils intubation fiberscope (Karl Storz GmbH & Co KG; Tuttlingen, Germany), the patients ($n = 82$) were randomly divided into 2 groups using a random number sequence: conventional group or laryngoscope group. The TEE probe (SONOS 4500, Philips, Böblingen, Germany; OmniPlane II Model 21369A, Philips, Bothell, WA) was lubricated before the insertion. The size of the probe tip was 14.5 (width) \times 42 (length) \times 11.5 mm (height), and the shaft was 10.5 mm in diameter and 100 cm in length. In the conventional group, the TEE probe was inserted blindly through the midline after the mandible was lifted and slightly flexed. In the laryngoscope group, a Macintosh laryngoscope was placed to visualize the esophageal inlet before the

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Table 1. Comparisons of Trauma-related Factors between Two Groups

Factors	Conventional Group (n = 40)	Laryngoscope Group (n = 40)	P Value
Trial number of TEE insertion	1.4 ± 0.5	1.1 ± 0.4	0.012
Number of patients with blood on the tip of TEE probe	15 (37.5%)	1 (2.5%)	0.000
Number of patients with oropharyngeal trauma	22 (55%)	2 (5%)	0.000
Number of trauma sites*			
Posterior wall	16	2	
Uvula	4	0	
Vallecula	4	0	
Pilla & tonsillar fossa	2	0	
Total	26	2	0.000
Number of patients with odynophagia	13 (32.5%)	1 (2.5%)	0.000
Number of patients with oropharyngeal pain	5 (12.5%)	1 (2.5%)	0.092

* Four patients in conventional group had 2 injury sites, respectively (Mann-Whitney U test, $U = 365.00$, $Z = -5.005$, $P = 0.000$).

TEE = transesophageal echocardiography.

insertion of the TEE probe. The TEE probe was inserted by the same anesthesiologist, who was qualified and experienced in intraoperative TEE. The number of TEE probe insertion attempts was counted. After 3 failed attempts, the case was defined as unsuccessful and was excluded from the study. Systolic blood pressure, diastolic blood pressure, mean blood pressure, and pulse rate per minute just before and after TEE probe insertion were recorded. After performing cardiac evaluations for about 20 min, the probe was removed. The tip of the TEE probe was examined for the presence of the blood. In this study, oropharyngeal injury was defined as laceration or hematoma which can be observed with a Bonfils intubation fiberscope. An anesthesiologist who was blinded to the study group evaluated oropharyngeal injury with a Bonfils intubation fiberscope. In patients with injuries, the location and the number of injury sites were recorded. In the evening of postoperative Day 1, the patients were asked if they had any discomfort in swallowing saliva (odynophagia) or oropharyngeal pain. The patients were followed up until discharge, and medical records were reviewed for the evaluation of other injuries such as esophageal injury or gastric bleeding.

Sample size was predetermined using a power analysis based on the assumptions that (1) the incidence of oropharyngeal mucosal injury with the blind insertion technique would be about 50% (based on the results of preliminary study with sample size of 10); (2) a reduction of oropharyngeal mucosal injury from 50% to 10% with the laryngoscope-assisted technique was considered of clinical importance; and (3) $\alpha = 0.05$ with a power ($1-\beta$) of 0.8. Statistical analysis was performed using Statistics Package for Social Sciences 12.0 software (SPSS, Inc., Chicago, IL). Continuous variables were reported as mean ± SD and were analyzed using an independent sample Student *t* test and paired Student *t* test. The Fisher exact test and Mann-Whitney U test were used for the incidence of oropharyngeal mucosal injury, odynophagia, and oropharyngeal pain. A value of $P < 0.05$ was considered significant.

Results

A total of 80 out of 86 patients (40 in each group) completed the study protocol. Four cases were excluded because of oropharyngeal injury during intubation, and 2 cases in the conventional group were excluded because of unsuccessful TEE probe insertion. There were no cases of unsuccessful TEE probe insertion in the laryngoscope group. Demographic characteristics are similar between 2 groups. Hemodynamic data were comparable between the 2 groups before TEE, and remained unaltered after TEE insertion.

There were significant differences in injury-related factors between the 2 groups, except for oropharyngeal pain (table 1). The number of TEE probe insertion attempts, the number of patients with blood on the tip of TEE probe, and the incidence of oropharyngeal mucosal injury were lower in the laryngoscope group as compared with those in the conventional group (1.1 ± 0.4 vs. 1.4 ± 0.5 , 2.5% vs. 37.5%, and 5% vs. 55%, respectively) (all $P < 0.05$).

The number of oropharyngeal injury sites in the conventional group was 26, but only 2 sites were found in the laryngoscope group (Mann-Whitney U test, $U = 365.00$, $Z = -5.005$, $P < 0.001$). The number of patients with odynophagia was significantly lower in the laryngoscope group as compared with that in the conventional group ($P < 0.05$). There was no significant difference in oropharyngeal pain between the 2 groups.

All patients with oropharyngeal injury were discharged from the hospital without further complications. Medical record review follow-up demonstrated no specific serious injuries such as esophageal rupture or gastric bleeding in either group.

Discussion

Although TEE is relatively safe as compared with other cardiac procedures, it is associated with various complications. Most of them are a form of anatomic structural damage along the insertion path, including the teeth,

tongue, oropharynx, hypopharynx, and esophagus.¹⁻⁶ Fortunately, most complications are either minor mucosal injuries or bleeding. However, more serious cases such as arytenoid dislocation,⁷ esophageal perforation,⁸ hypopharyngeal perforation with abscess, and mediastinitis⁹ have been reported.

TEE insertions in anesthetized patients are more difficult than those performed in conscious patients because oral passages are obstructed. In a retrospective case series of 7,200 anesthetized adult patients, Kallmeyer *et al.*³ reported that 0.2% overall morbidity was associated with intraoperative TEE, with severe odynophagia being the most frequent complication. In this study, although odynophagia was also the most frequent complication, the incidence of odynophagia was much higher than that reported by Kallmeyer *et al.*³ (32.5% vs. 0.1%, respectively). This can be explained by the difference in the definition of odynophagia. The study by Kallmeyer *et al.*³ was a retrospective study, and odynophagia was defined as discomfort in swallowing that was severe and persistent enough to warrant diagnostic esophagogastroduodenoscopy, whereas in this study, odynophagia was defined as the occurrence of symptom itself, regardless of its severity.

In a recent study, a fiber-optic flexible laryngoscope with a video monitor was successfully used to decrease the number of injuries associated with TEE probe insertion.¹⁰ The authors placed the flexible laryngoscope through the patients' nose to guide the TEE probe's passage. They reported that this maneuver decreased hypopharyngeal injuries by reducing the number of contacts made with hypopharyngeal structures such as the arytenoids, pyriform sinuses, vocal folds, and trachea. However, it is neither common nor easy to use a fiber-optic flexible laryngoscope during TEE probe insertion. On the other hand, a rigid laryngoscope is a simple airway management tool that is familiar to all anesthesiologists. It has also been used by anesthesiologists when blind insertion of the nasogastric tube or TEE probe was unsuccessful.^{3,5}

Authors in this study hypothesized that contact with oropharyngeal structures in the conventional group would be far higher than that in the laryngoscope group, and therefore the oropharyngeal injury rate would also be far higher in the conventional group. The size or type

of TEE probe may affect the incidence of oropharyngeal injury. In this study, the probe used was a standard size for most adults. Further studies are needed to clarify whether the TEE size or types affect the incidence of oropharyngeal injury.

In this study, vital signs did not change with the use of a laryngoscope during TEE insertion, which can be harmful in patients with cardiovascular disease. Besides oropharyngeal pain and odynophagia, bleeding is another complication after TEE probe insertion. Since high-risk cardiac patients who are often anticoagulated are the most likely population to require TEE assessment, laryngoscopy-assisted techniques may further benefit those patients.

In conclusion, a rigid laryngoscope-assisted insertion of the TEE probe is recommended in anesthetized patients because this technique reduces the incidence of oropharyngeal mucosal injury and odynophagia without the hemodynamic changes associated with laryngoscopy.

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