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윤상갑상막 위치식별을 위한
후두악수법의 효용

Utility of the Laryngeal Handshake Method
for Identifying the Cricothyroid Membrane

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ABSTRACT

Utility of the Laryngeal Handshake Method for Identifying the Cricothyroid Membrane

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Background: The cricothyroid membrane is the most commonly accessed location for invasive surgical airway. Although the laryngeal handshake method is recommended for identifying the cricothyroid membrane, there is no clinical data regarding the utility of the laryngeal handshake method in cricothyroid membrane identification. The objective of this study was to compare the accuracy of cricothyroid membrane identification between the laryngeal handshake method and simple palpation.

Methods: After anesthesia induction, the otorhinolaryngology resident and anesthesiology resident identified and marked the needle insertion point for cricothyroidotomy using simple

palpation and the laryngeal handshake method, respectively. The cricothyroid membrane was confirmed with ultrasonography. Identification was determined successful if the marked point was placed within the longitudinal area of the cricothyroid membrane and within 5 mm from midline transversely. The accuracy of cricothyroid membrane identification using the laryngeal handshake method and simple palpation was compared.

Results: A total of 123 patients were enrolled. The cricothyroid membrane was correctly identified in 87 (70.7%, 95% confidence interval 61.8–78.6%) patients using the laryngeal handshake method compared to 78 (63.4%, 95% confidence interval 54.3–71.9%) patients using simple palpation ($P = .188$). The time required to identify the cricothyroid membrane was longer when using the laryngeal handshake method (15 [3–48] seconds vs 10.9 [3–55] seconds, $P = .003$).

Conclusion: The success rate of identifying the cricothyroid membrane was similar among the anesthesiologists who performed the laryngeal handshake method and also among otorhinolaryngologists who used simple palpation.

Keywords: cricothyroid membrane, laryngeal handshake, difficult airway

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INTRODUCTION

In the event of an emergent difficult airway situation, the surgical airway is the final option with most difficult airway guidelines proposing cricothyroidotomy.^{1,2} The cricothyroid membrane, which is located between the thyroid cartilage and the cricoid cartilage, is identified and accessed when cricothyroidotomy is required. Despite its relatively simple superficial anatomy, it is often difficult to identify the cricothyroid membrane using simple palpation.³

The laryngeal handshake method is recommended for identifying the cricothyroid membrane in the Difficult Airway Society 2015 guidelines when performing cricothyroidotomy in emergent situations such as unanticipated difficult intubation.² To identify the cricothyroid membrane using the laryngeal handshake method, the greater cornu of the hyoid bone is palpated and traced to identify the trachea. However, the recommendation lacks supporting clinical data, especially with regard to how much the laryngeal handshake method improves the accuracy of the cricothyroid membrane identification.⁴

We hypothesized that the cricothyroid membrane would be identified more accurately when the laryngeal handshake method is used compared to simple palpation. The aim of this study was to compare the accuracy of finding the cricothyroid membrane between using the laryngeal handshake method and simple palpation.

METHODS

The study protocol was approved by the Institutional Review Board (IRB) of Seoul National University College of Medicine and Seoul National University Hospital (101, Daehak-ro, Jongno-gu, Seoul, Republic of Korea) on 18 April 2017 and Seoul Metropolitan Government-Seoul National University (SMG-SNU) Boramae Medical Center IRB (20, Boramae-ro 5-gil, Dongjak-gu, Seoul, Republic of Korea) on May 22, 2017. (IRB number: H-1704-035-844) and registered on clinicaltrials.gov (NCT03196752). Written informed consent was obtained from all patients during the pre-anesthetic visit.

Study Population

Patients scheduled for nose or ear surgery at Seoul National University Hospital or SMG-SNU Boramae Medical Center were eligible for study participation. Patients who were <20 years old, >80 years old, or ASA class >3 were excluded from the study. Patients with a history of neck surgery or with anatomical anomaly or skin lesion in the cervical area were also excluded.

The Laryngeal Handshake Method

The larynx is a conical shaped structure consisted of bone and cartilage. The laryngeal handshake method has been proposed to facilitate recognition of the conical contour of the larynx and identification of the cricothyroid membrane.² The first step is to

palpate the greater cornu of the hyoid bone with the thumb and middle finger of the non-dominant hand. The conical structure of the larynx was traced caudally by shaking the larynx right and left. When the thyroid lamina is palpated, the cricoid cartilage is held with the thumb and middle finger and the cricothyroid membrane is identified by the index finger (Figure 1).²

Study Protocol

The anesthesiologists participating in this study received education regarding the laryngeal handshake method by reading the laryngeal handshake method section of the Difficult Airway Society 2015 guidelines and watching a video demonstrating the method.^{2,4} Educational material was not provided to the otorhinolaryngologists prior to the study.

anesthesia was induced with propofol 2 mg/kg, fentanyl 1 mcg/kg, and rocuronium 0.6 mg/kg and maintained with 1.5–2.5% sevoflurane. During mask ventilation with oxygen and sevoflurane, the patient's neck was extended to expose the neck. The otorhinolaryngology resident in the operating room was asked to inspect and palpate the patient's neck (simple palpation) and mark the center of the cricothyroid membrane using a pen filled with special ink that is visible only under ultraviolet light. The time required to mark the cricothyroid membrane was measured and the subjective difficulty in identifying the cricothyroid membrane on 4 scale system (1—very easy, 2—easy, 3—difficult and 4—very difficult) was recorded. Afterwards, an anesthesiology resident who did not witness the otorhinolaryngology resident's marking was asked

to mark the center of the cricothyroid membrane using the laryngeal handshake method with a regular pen.

After the two points were marked, the cricothyroid membrane was verified using the longitudinal technique (Vscan, GE healthcare, Chicago, IL, USA).⁵ The midline of anterior neck at the level of thyroid cartilage was identified and the point just above the superior vertex of triangle that consists of thyroid cartilage and vocal fold was marked. The ultrasound probe was placed longitudinally around thyroid cartilage and cricoid cartilage to identify the cricothyroid membrane. The cephalic margin of the cricothyroid membrane was marked just above the caudal end of the thyroid cartilage and the caudal margin of the cricothyroid membrane was marked just above the cephalic end of cricoid cartilage (Figure 2). The anesthesiologists who identified the cricothyroid membrane were experienced in using the ultrasonography and were educated by an expert anesthesiologist/intensivist who had previously performed multiple ultrasonography of the neck, including the cricothyroid membrane.

The cephalocaudal length of the cricothyroid membrane and the distance from the center of the cricothyroid membrane (identified via ultrasonography) to the two previously marked points were measured. When the marked points were within the cephalocaudal margins of the cricothyroid membrane and within 5 mm from the midline, it was considered as successful identification of the cricothyroid membrane. The patient's neck circumference, thyromental distance, and thyrosternal distance were also measured.

The primary outcome was the success rate of cricothyroid

membrane identification. Secondary outcomes included the accuracy difference between the direction and distance from the center of the cricothyroid membrane to two marks, perceived difficulty (4 scale system: 1—very easy, 2—easy, 3—difficult and 4—very difficult) in identifying the cricothyroid membrane and the time required to identify and mark the cricothyroid membrane.

Statistical Analysis

Based on a previous study that showed 24% accuracy in identifying the cricothyroid membrane and the assumption that a 75% accuracy would be clinically meaningful when the laryngeal handshake method is used, a sample size of 117 was calculated.³ The alpha error was 0.05 and the power was 80%.

We analyzed the categorical values using the number or percentage and the continuous values using the mean with standard deviation or the median with range. Normality of distribution was estimated by Shapiro–Wilk test and 95% confidence interval was calculated as Clopper–Pearson interval. Paired t–test was used to compare continuous variables and McNemar test, Pearson’ s Chi–squared test or Fisher’ s exact test was performed to compare categorical variable. A P–value of <.05 was considered statistically significant. All results were analyzed statistically using IBM SPSS Statistics 23.

RESULTS

A total of 123 patients were enrolled in the study and the cricothyroid membrane of all patients was identified successfully. Patient characteristics are summarized in Table 1. A total of eight anesthesiologists (2–43 assessments per anesthesiologist) and fourteen otorhinolaryngologists (1–20 assessments per otorhinolaryngologist) participated in this study.

There was no statistically significant difference in success rate of cricothyroid membrane identification between simple palpation and the laryngeal handshake method (87/123, 70.7%, 95% confidence interval (CI) 61.9–78.6% vs 78/123, 63.4%, 95% CI 54.3–71.9%, $P = .188$) as shown in Table 2. Patients were divided into two subgroups based on mean, median, and specific values according to the normality of the variables and subgroup analysis showed no difference in success rate between anesthesiologists using the laryngeal handshake method and otorhinolaryngologists using simple palpation.

The distance from the center of the cricothyroid membrane to the points marked using simple palpation and the laryngeal handshake method were similar (2.83 [0–25.5] mm vs 4 [0–25] mm, $P = .139$) as shown in Table 3. They were also similar both longitudinally (0 [–25–20] mm vs 0 [–20–20] mm, $P = .196$) and transversely (0 [–13–15] mm vs 0 [–15–15] mm, $P = .841$). Figure 3 shows the distribution of marked points using simple palpation and the laryngeal handshake method, relative to the center of the cricothyroid membrane. There was no difference in the perceived difficulty in identifying the cricothyroid membrane using simple palpation and the laryngeal

handshake method (2 [1–4] vs 2 [1–4], $P = .412$). However, the time required to identify the cricothyroid membrane was longer when using the laryngeal handshake method (15 [3–48] seconds vs 10.9 [3–55] seconds, $P = .003$).

We also compared the laryngeal handshake method and simple palpation by applying different definitions of successful cricothyroid membrane identification (Table 4). There were no significant difference in success rate of cricothyroid membrane identification between anesthesiologists and otorhinolaryngologists even if the definition of successful identification were changed to the marked points within cephalocaudal margins of the cricothyroid membrane and within 3 mm (80/123, 65.0%, 95% CI 55.9–73.4% vs 68/123, 55.3%, 95% CI 46.1–64.2%, $P = 0.88$) or 10 mm (94/123, 76.4%, 95% CI 67.9–83.6% vs 86/123, 69.9%, 95% CI 61.0–77.9%, $P = .280$) from the midline. Participants using the laryngeal handshake method identified the midline of the neck more accurately compare to those using simple palpation (111/123, 90.2%, 95% CI 83.6–94.9% vs 101/123, 82.1%, 95% CI 74.2–88.4%, $P = .041$), whereas identified the cephalocaudal location of the cricothyroid membrane similarly to those using simple palpation (94/123, 76.4%, 95% CI 67.9–83.6% vs 89/123, 72.4%, 63.6–80.0%, $P = .542$). The number of marked points within the circles with a radius of 3, 5 and 10 mm were 66 vs 55, 87 vs 78, and 114 vs 103 with the laryngeal handshake method and simple palpation, respectively and there were no statistically significant difference between the two methods (Figure 3).

There was no significant difference in the success rate of cricothyroid membrane identification between early 5 attempts

(21/31, 67.7%, 95% CI 48.6–83.3% vs 66/92, 71.6%, 95% CI 61.4–80.6%, $P = .672$) or 10 attempts (36/53, 67.9%, 95% CI 53.7–80.1% vs 51/70, 72.9%, 95% CI 60.9–82.8%, $P = .552$) and subsequent attempts (Table 5). Subgroup analysis showed no significant difference in success rate between early attempts and subsequent attempts in individuals.

The success rate of first and second year resident for identifying cricothyroid membrane was similar to that of third and fourth year resident in the both subspecialty of anesthesiology (19/24, 79%, 95% CI 57.8–92.9% vs 68/99, 68.7%, 95% CI 58.6–77.6%, $P = .311$) and otorhinolaryngology (54/88, 61.4%, 95% CI 50.4–71.6% vs 24/35, 68.6%, 95% CI 50.7–83.1%, $P = .454$) as shown in Table 6.

Table 7 shows the normality of the variables including patient characteristics and secondary outcomes. Only height ($P = .061$) and neck circumference ($P = .235$) showed the normality.

Tables

Table 1. Patient characteristics receiving the laryngeal handshake method or simple palpation for cricothyroid membrane identification

Variables	
Number of patients	123
Male/Female	75/48
Age (y)	57 [20–97]
Height (cm)	163.8 (9.5)
Weight (kg)	66.1 [36.5–108]
body mass index (kg/m ²)	24.2 [17.2–34.9]
Neck circumference (cm)	38.1 (4.1)
Thyromental distance (cm)	6.5 [3.7–10.3]
Thyrosternal distance (cm)	5.5 [2–13]
Longitudinal length of cricothyroid membrane (cm)	1.0 [0.4–2.8]

Values are number, ratio, mean (standard deviation) or median [range].

Table 2. Comparison of primary outcome between the laryngeal handshake method and simple palpation for cricothyroid membrane identification

Success rate	Laryngeal handshake method (anesthesiologist)	Simple palpation (otorhinolaryngologist)	<i>P</i>
Overall	70.7% (87/123) [61.9–78.6%]	63.4% (78/123) [54.3–71.9%]	.188
Male	81.3% (61/75) [70.7–89.4%]	73.3% (55/75) [61.9–82.9%]	.238
Female	54.2% (26/48) [39.2–68.6%]	47.9% (23/48) [33.3–62.8%]	.648
Age <57	76.3% (45/59) [63.4–86.4%]	67.8% (40/59) [54.4–79.4%]	.359
Age ≥57	65.6% (42/64) [52.7–77.1%]	59.4% (38/64) [46.4–71.5%]	.481
Height <163.8 cm	65.6% (40/61) [52.3–77.3%]	54.1% (33/61) [40.9–66.9%]	.210
Height ≥163.8 cm	75.8% (47/62) [63.3–85.8%]	72.6% (45/62) [59.8–83.1%]	.791
Weight <66.1 kg	60.7% (37/61) [47.3–72.9%]	52.5% (32/61) [39.3–65.4%]	.383
Weight ≥66.1 kg	80.6% (50/62) [68.6–89.6%]	74.2% (46/62) [61.5–84.5%]	.454
Body mass index <24.2 kg/m ²	72.1% (44/61) [59.2–82.9%]	57.4% (35/61) [44.1–70.0%]	.078
Body mass index ≥24.2 kg/m ²	69.4% (43/62) [56.4–80.4%]	69.4% (43/62) [56.4–80.4%]	1.000
Body mass index <30 kg/m ²	70.2% (80/114) [60.9–78.4%]	63.2% (72/114) [53.6–72.0%]	.229
Body mass index ≥30 kg/m ²	77.8% (7/9) [40–97.2%]	66.7% (6/9) [29.9–92.5%]	1.000
Neck circumference <38 cm	64.4% (38/59) [50.9–76.4%]	55.9% (33/59) [42.4–68.8%]	.359
Neck circumference ≥38 cm	76.6% (49/64) [64.3–86.2%]	70.3% (43/64) [54.3–78.4%]	.481
Neck circumference <40 cm	69.2% (54/78) [57.8–79.2%]	59.0% (46/78) [47.3–70.0%]	.152

Neck circumference ≥ 40 cm	73.3% (33/45) [58.1–85.4%]	71.1% (32/45) [55.7–83.6%]	1.000
Thyromental distance < 6.5 cm	66.7% (36/54) [52.5–78.9%]	59.3% (32/54) [45.0–72.4%]	.503
Thyromental distance ≥ 6.5 cm	73.9% (51/69) [61.9–83.7%]	66.7% (46/69) [54.9–77.6%]	.332
Thyrosternal distance < 5.5 cm	65.1% (28/43) [49.1–79.0%]	48.8% (21/43) [33.3–64.5%]	.092
Thyrosternal distance ≥ 5.5 cm	73.8% (59/80) [62.7–83.0%]	71.3% (57/80) [60.0–80.8%]	.839
Longitudinal length of CTM < 1 cm	60.0% (33/55) [45.9–73.0%]	54.5% (30/55) [40.6–68.0%]	.629
Longitudinal length of CTM ≥ 1 cm	79.4% (54/68) [67.9–88.3%]	70.6% (48/68) [58.3–81.0%]	.263
1st & 2nd year resident	79.2% (19/24) [57.8–92.9%]	61.4% (54/88) [50.4–71.6%]	.105
3rd & 4th year resident	68.7% (68/99) [58.6–77.6%]	68.6% (24/33) [54.5–86.7%]	.990

Values are proportion (ratio) [95% confidence interval] or number. CTM: cricothyroid membrane

Table 3. Comparison of secondary outcomes between the laryngeal handshake method and simple palpation for cricothyroid membrane identification

Variables	Laryngeal handshake method (anesthesiologist)	Simple palpation (otorhinolaryngologist)	<i>P</i>
Distance from CTM center (mm)	2.83 [0–25.5]	4 [0–25]	.139
Longitudinal distance (mm)	0 [–25–20]	0 [–20–20]	.196
Transverse distance (mm)	0 [–13–15]	0 [–15–15]	.841
Difficulty of identification	2 [1–4]	2 [1–4]	.412
Time for identification (s)	15 [3–48]	10.9 [3–55]	.003

Values are median [range] or number. CTM: cricothyroid membrane

Table 4. Comparison between the laryngeal handshake method and simple palpation for cricothyroid membrane identification in different definition of success

Success rate in different definition	Laryngeal handshake method (anesthesiologist)	Simple palpation (otorhinolaryngologist)	<i>P</i>
Within 3 mm from midline & within cephalocaudal margins of CTM	65.0% (80/123) [55.9–73.4%]	55.3% (68/123) [46.1–64.2%]	.088
Within 10 mm from midline & within cephalocaudal margins of CTM	76.4% (94/123) [67.9–83.6%]	69.9% (86/123) [61.0–77.9%]	.280
Within cephalocaudal margins of CTM	76.4% (94/123) [67.9–83.6%]	72.4% (89/123) [63.6–80.0%]	.542
Within 5 mm from midline	90.2% (111/123) [83.6–94.9%]	82.1% (101/123) [74.2–88.4%]	.041
Within 3 mm from CTM center	53.7% (66/123) [44.4–62.7%]	44.7% (55/123) [35.7–53.9%]	.117
Within 5 mm from CTM center	70.7% (87/123) [61.9–78.6%]	63.4% (78/123) [54.3–71.9%]	.200
Within 10 mm from CTM center	92.7% (114/123) [86.6–96.6%]	83.7% (103/123) [76.0–89.8%]	.052

Values are proportion (ratio) [95% confidence interval] or number. CTM: cricothyroid membrane

Table 5. Comparison between early and subsequence attempts for cricothyroid membrane identification using the laryngeal handshake method

Success rate	Attempts <6	Attempts ≥6	<i>P</i>	Attempts <11	Attempts ≥11	<i>P</i>
Overall	67.7% (21/31) [48.6–83.3%]	71.6% (66/92) [61.4–80.6%]	.672	67.9% (36/53) [53.7–80.1%]	72.9% (51/70) [60.9–82.8%]	.552
Anesthesiologist 1	60.0% (3/5) [14.7–94.7%]	46.2% (6/13) [19.2–74.9%]	1.000	40.0% (4/10) [12.2–73.8%]	62.5% (5/8) [24.5–91.4%]	.637
Anesthesiologist 2	60.0% (3/5) [14.7–94.7%]	100% (2/2) [15.8–100.0%]	1.000	71.4% (5/7) [29.0–96.3%]	Not applicable	Not applicable
Anesthesiologist 3	100.0% (3/3) [29.2–100.0%]	Not applicable	Not applicable	100.0% (3/3) [29.2–100.0%]	Not applicable	Not applicable
Anesthesiologist 4	80.0% (4/5) [28.4–99.5%]	75.7% (28/37) [58.8–88.2%]	1.000	70.0% (7/10) [34.8–93.3%]	78.1% (25/32) [60.0–90.7%]	.678
Anesthesiologist 5	40.0% (2/5) [5.3–85.3%]	71.4% (15/21) [47.8–88.7%]	.302	60.0% (6/10) [26.2–87.8%]	68.8% (11/16) [41.3–89.0%]	.692
Anesthesiologist 6	66.7% (2/3) [9.4–99.1%]	Not applicable	Not applicable	66.7% (2/3) [9.4–99.1%]	Not applicable	Not applicable
Anesthesiologist 7	80.0% (4/5) [28.4–99.5%]	78.9% (15/19) [54.4–93.9%]	1.000	90.0% (9/10) [55.5–99.7%]	71.4% (10/14) [41.9–91.6%]	.358

Values are proportion (ratio) [95% confidence interval] or number.

Table 6. Comparison of success rate for cricothyroid membrane identification according to training period

Success rate	1st & 2nd year resident	3rd & 4th year resident	<i>P</i>
Laryngeal handshake method (anesthesiologist)	79.2% (19/24) [57.8–92.9%]	68.7% (68/99) [58.6–77.6%]	.311
Simple palpation (otorhinolaryngologist)	61.4% (54/88) [50.4–71.6%]	68.6% (24/35) [50.7–83.1%]	.454

Values are proportion (ratio) [95% confidence interval] or number.

Table 7. Shapiro–Wilk normality test for continuous variables

Variables	Statistic	P
Patient characteristics		
Age	.963	.002
Height	.980	.061
Weight	.948	<.001
Body mass index	.957	<.001
Neck circumference	.986	.235
Thyromental distance	.968	<.001
Thyrosternal distance	.922	<.001
Longitudinal length of cricothyroid membrane	.864	<.001
Secondary outcomes		
Laryngeal handshake method (anesthesiologist)		
Distance from cricothyroid membrane center	.791	<.001
Longitudinal distance	.843	<.001
Transverse distance	.690	<.001
Difficulty of identification	.858	<.001
Time for identification	.897	<.001
Simple palpation (otorhinolaryngologist)		
Distance from cricothyroid membrane center	.858	<.001
Longitudinal distance	.852	<.001
Transverse distance	.839	<.001
Difficulty of identification	.859	<.001
Time for identification	.808	<.001

Figures

Figure 1. Laryngeal handshake method



The fingers first palpate the hyoid bone (left), then the thyroid lamina (middle), and the cricoid cartilage and cricothyroid membrane (right).

Figure 2. Cricothyroid membrane visible in ultrasonography by longitudinal technique

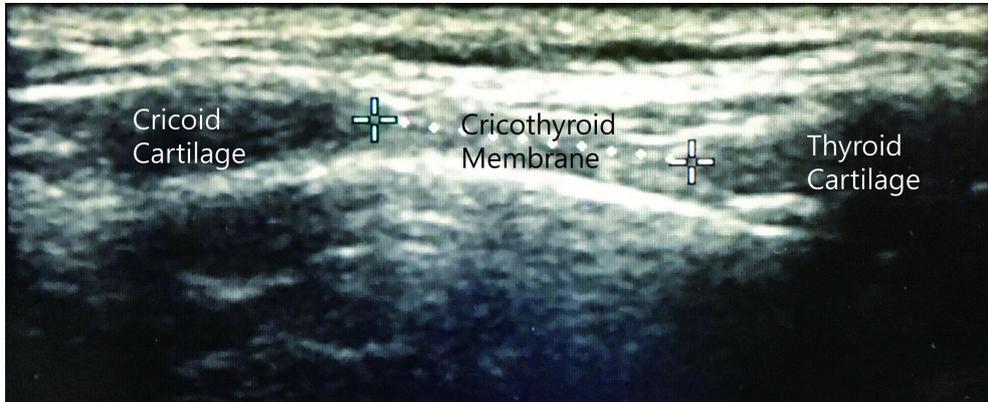
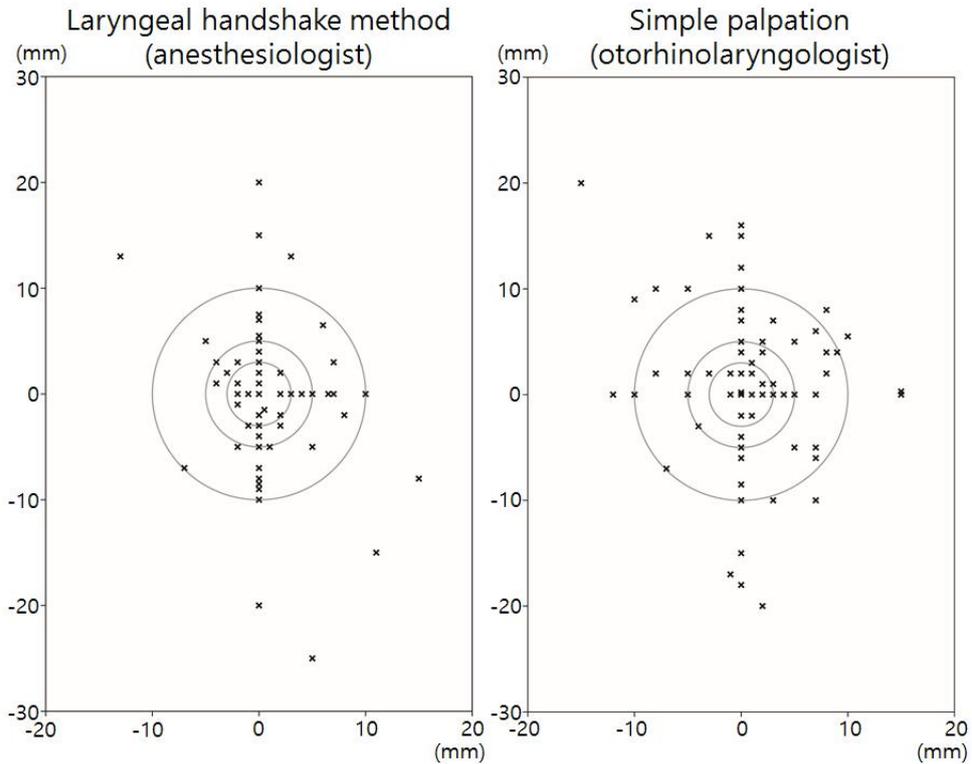


Figure 3. Scatter plot of marked points by anesthesiologists using the laryngeal handshake method (left) and otorhinolaryngologists using simple palpation (right)



Some symbols were superimposed and the diameters of circles are 6, 10, and 20 mm, respectively.

DISCUSSION

The use of laryngeal handshake method by anesthesiologists showed similar accuracy as simple palpation by otorhinolaryngologists in identifying the cricothyroid membrane. Although the time required to identify the cricothyroid membrane using the laryngeal handshake method was longer compared to simple palpation, there was no difference in perceived difficulty.

The low success rate of several techniques in identifying the cricothyroid membrane has led to the recommendation of vertical incision for cricothyroidotomies when anterior neck anatomical landmarks are not palpable.^{2,6} Sex and obesity are the two commonly studied factors that may influence the identification of the cricothyroid membrane. In a previous study on the influence of obesity in successful identification of the cricothyroid membrane using the same definition of success as our study, the success rate was 3.3% in obese females compared to 26.8% in nonobese females.³ In our study, patients with body mass index (BMI) higher than 30 kg/m² showed similar success rate compared to patients with BMI less than 30 kg/m². The discrepancy may be due to inclusion of males who have more prominent anatomical landmarks. Successful identification of the cricothyroid membrane was compared between males and females in a previous study.⁵ The success rate, also using the same definition as our study, with simple palpation was 19.4% in females compared to 69.4% in males.⁵ Another study compared the success rate between trauma surgeons and anesthesiologists in identifying the cricothyroid membrane in female patients.⁶ The overall success rate was 18.0% and trauma surgeons showed a

success rate of 26% compared to 16.2% in anesthesiologists.⁶ The relatively higher success rate in females in our study compared to previous studies may be due to different portion of obese female.

The laryngeal handshake method is recommended in the Difficult Airway Society 2015 guidelines as a tool for identifying the cricothyroid membrane.² Although the laryngeal handshake method has been described in the literature for identifying the cricothyroid membrane, there has been no clinical data regarding the accuracy of the laryngeal handshake method in identifying the cricothyroid membrane.^{2,7,8} Our results are the first clinical data regarding the use of laryngeal handshake method compared to simple palpation or any other method used in identifying the cricothyroid membrane.

In the hands of anesthesiologists who are experienced in airway ultrasonography, the success rate of identification of the cricothyroid membrane is invariably close to 100 percent which was also the case in this study where the cricothyroid membrane was successfully identified in all 123 patients.⁹ Ultrasonography may be the most reliable method for finding the cricothyroid membrane, as it allows direct visualization of the cricothyroid membrane by identifying relatively easy to find adjacent structures such as the thyroid cartilage and the cricoid cartilage.⁹ The cricothyroid membrane can be identified with the ultrasonography using two approaches: the transverse technique and the longitudinal technique. The two techniques have shown similar accuracy of about 90% with the transverse technique requiring less time.¹⁰

The comparison between simple palpation and ultrasonography

in identifying the cricothyroid membrane are inconsistent. In a study on healthy volunteers with a mean BMI of 23.8, the success rate of identifying the cricothyroid membrane using the simple palpation was 66.7%, which was similar to 69.2% when using ultrasonography whereas the cricothyroid membrane was identified more quickly when using simple palpation.¹¹ In morbidly obese females the success rate of identifying the cricothyroid membrane was more than doubled (palpation 37%, ultrasonography 83%) when ultrasonography was used by anesthesiologists with no prior experience with airway ultrasonography but who had learnt a structured approach to ultrasonographic identification of the membrane.¹² In a cadaveric study, there was a higher rate of introducing the cricothyroid cannula through the cricothyroid membrane, less injury to the larynx and trachea and less time required for cricothyroid cannula insertion, when the cannulation was guided by ultrasonography as opposed to simple palpation.¹³ It was also reported that the use of ultrasonography was associated with higher success rate in identifying the cricothyroid membrane compared to inspection or palpation, especially in obese patients.⁹

Several limitations should be considered when interpreting our data. Since the laryngeal handshake method was performed by anesthesiologists and simple palpation performed by otorhinolaryngologists, direct comparison between the two methods was not possible. However, the non-inferior results of the laryngeal handshake method performed by anesthesiologists may suggest the utility of the laryngeal handshake method for physicians not specialized in surgical airway management.

Second, the learning curve of anesthesiologists and otorhinolaryngology residents were not considered in our study. The number of participation in the study was not controlled and may have affected the results. Third, there was no time limit in identifying the cricothyroid membrane. Therefore, success rate may have been influenced by the level of determination of anesthesiology and otorhinolaryngology residents. However, the residents were asked to identify the cricothyroid membrane as quickly as possible and were cognizant that time was being recorded. Forth, the definition of success in our study was within 5 mm of the cricothyroid membrane center identified by ultrasonography. Success rates may differ depending on how success is defined and may have different clinical implications. However, most previous studies about cricothyroid membrane identification used the same definition of successful cricothyroid membrane identification as our study.^{3,5,6}

In conclusion, the laryngeal handshake method recommended for identifying the cricothyroid membrane seems to be a useful method. The success rate of laryngeal handshake method by anesthesiologists was similar to simple palpation by otorhinolaryngologists.

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초록

윤상갑상막 위치식별을 위한 후두악수법의 효용

배경: 윤상갑상막은 침습적인 기도확보를 위해 가장 보편적으로 접근되는 부위이다. 윤상갑상막의 위치를 식별할 때 후두악수법을 사용하는 것이 권고되지만 윤상갑상막의 위치식별을 위한 후두악수법의 효용에 대한 임상자료 없다. 이에 이 연구에서는 후두악수법과 단순촉지 사이의 윤상갑상막 위치식별의 정확성을 비교하고자 하였다.

방법: 마취유도 후 이비인후과 전공의와 마취통증의학과 전공의가 각각 단순촉지와 후두악수법을 사용하여 윤상갑상막절개를 위한 바늘삽입부위를 식별하고 표시하였다. 윤상갑상막은 초음파검사로 확인하였다. 표시한 점이 횡으로 정중선에서 5 mm 이내, 종으로 윤상갑상막 범위 내에 위치한 경우 성공적으로 위치를 식별한 것으로 판정하였다. 후두악수법과 단순촉지를 이용한 윤상갑상막 위치식별의 정확도를 비교하였다.

결과: 총 123명의 환자가 연구대상이 되었다. 윤상갑상막은 단순촉지를 사용했을 때에는 78 (63.4%, 95% 신뢰구간 54.3–71.9%) 명의 환자에서 정확히 식별된 것과 비교하여 후두악수법을 사용했을 때에는 87 (70.7%, 95% 신뢰구간 61.8–78.6%) 명의 환자에서 정확히 식별되었다 ($P = .188$). 윤상갑상막을 식별하는 데 소요된 시간은 후두악수법을 사용했을 때 더 길었다 (15 [3–48] 초 대 10.9 [3–55] 초, $P = 0.03$).

결론: 후두악수법을 사용한 마취통증의학과 의사와 단순촉지를 사용한 이비인후과 의사의 윤상갑상막 위치식별의 성공률에는 차이가 없었다.

주요어: 윤상갑상막, 후두악수, 어려운 기도

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