

# Use of Bedside Sonography for Diagnosing Acute Epiglottitis in the Emergency Department

## A Preliminary Study

Dong Ryul Ko, MD, Yong Eun Chung, MD, Incheol Park, MD, Hye-Jeong Lee, MD, Jong Woo Park, MD, Je Sung You, MD, Tae Nyoungh Chung, MD, Yoo Seok Park, MD, Sung Phil Chung, MD, Seungho Kim, MD

**Objectives**—The purpose of this study was to investigate the ability of sonography to identify acute epiglottitis in the emergency department.

**Methods**—Fifteen patients with a final diagnosis of acute epiglottitis from indirect laryngoscopy by an otolaryngologist were enrolled in the study. To compare the normal epiglottis and acute epiglottitis, 15 healthy volunteers were assigned to a control group. The sonographic appearances of the epiglottitis and the pre-epiglottic space were recorded. The anteroposterior diameter of the epiglottis at the midpoint and both edges in a transverse view was measured in all participants.

**Results**—A statistically significant difference ( $P < .001$ ) was observed in the anteroposterior diameter of the epiglottis at the midpoint and both lateral edges between the patients and healthy volunteers. However, there was overlap in the ranges for the midpoint but no overlap in both lateral edges between groups. The upper-limit value for the healthy control group was 3.2 mm at both lateral edges, whereas the cutoff values of the right and left edges were 3.7 and 3.6 mm, respectively, according to the lower-limit value for the epiglottitis group.

**Conclusions**—The anteroposterior diameter of the epiglottis was significantly different between the patients with epiglottitis and the healthy volunteers. Because of this significant difference in the anteroposterior diameter of the epiglottis, sonography can be used as a rapid, noninvasive, and effective diagnostic tool for identifying cases of epiglottitis in the emergency department.

**Key Words**—acute epiglottitis; epiglottis; sonography

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Address correspondence to Je Sung You, MD, Department of Emergency Medicine, Yonsei University College of Medicine, 250 Sungsan-Ro, Seodaemun-Gu, Seoul 135-720, Korea.

E-mail: youjsmd@yuhs.ac

### Abbreviations

ED, emergency department

Acute epiglottitis is a serious life-threatening disease characterized by inflammation of supraglottic structures. The incidence of this condition in adults is about 1 per 100,000 with mortality in the range of 6% to 7%.<sup>1-3</sup> Early diagnosis is extremely important because of the rapid and progressive disease course.<sup>4</sup> If clinicians in the emergency department (ED) do not suspect the presence of acute epiglottitis, it is difficult to diagnose this disease in adults because it is usually accompanied by nonspecific symptoms such as sore throat and odynophagia and is less likely to present with dyspnea, drooling, and stridor.<sup>2</sup>

Recently, sonography has been made available in most EDs. Several studies reported that sonography can accurately evaluate epiglottitis in ED settings.<sup>2,5-7</sup> However, no studies have compared

sonograms of the normal epiglottis and acute epiglottitis taken in the ED. The purpose of this study was to investigate the use of sonography for diagnosing acute epiglottitis in the ED.

## Materials and Methods

We conducted a prospective study of healthy volunteers and patients with a diagnosis of acute epiglottitis after presenting to the ED. The study protocol was reviewed and approved by the Institutional Review Board. Between January 2010 and April 2011, 15 consecutive patients with a final diagnosis of acute epiglottitis from indirect laryngoscopy by an otolaryngologist were enrolled in the study. Patients with a known history of laryngeal disease or laryngeal surgery as well as pediatric patients (<15 years) were excluded. To compare healthy individuals and patients with acute epiglottitis, 15 healthy volunteers were assigned to a control group. The study was described to all participants, and written consent was obtained from all.

Sonography was performed in the ED with a LOGIQ P5 system (GE Healthcare, Milwaukee, WI) and a 5- to 10-MHz linear array transducer. The emergency physician, with 10 years of experience performing sonography, was blinded to the clinical results. The participants were imaged in an upright seated position with the neck minimally extended.<sup>2</sup> The epiglottis was visible through the thyrohyoid membrane as a hypoechoic curvilinear structure in a transverse view.<sup>7</sup> The sonographic appearances of the epiglottitis and pre-epiglottic space were recorded.<sup>2</sup> The anteroposterior diameter of the epiglottis at the midpoint and both edges (right and left sides relative to the patient) in the transverse view was measured in all participants.

For statistical analysis, continuous variables are expressed as mean and standard deviation. Differences in height and the anteroposterior diameter of the epiglottis (right edge, midpoint, and left edge) were compared by a Student *t* test. Differences in weight and age were evaluated by a Mann-Whitney test. A  $\chi^2$  test was used to compare the two groups according to sex. Two-sided  $P < .05$  was considered statistically significant. Receiver operating characteristics analysis was used to identify cutoff values for the anteroposterior diameter of the epiglottis. SPSS version 18.0 software for Windows (SPSS Inc, Chicago, IL) was used to perform the statistical analysis.

## Results

Table 1 shows the demographic data and anteroposterior diameters of the three points of the epiglottis. A statisti-

cally significant difference ( $P < .001$ ) was observed in the anteroposterior diameter of the epiglottis at the midpoint and both lateral edges between the epiglottitis and control groups.

There was overlap in the ranges for anteroposterior measurements of the epiglottis at the midpoint between groups (Figure 1B). The thickness ranges for the midpoint in the healthy control and epiglottitis groups were 2.0 to 3.4 and 2.2 to 6.8 mm, respectively. However, there were no overlapping areas between the two groups in both lateral edges (Figure 1, A and C). The upper-limit value of the healthy control group was 3.2 mm at both lateral edges, whereas the cutoff values of the right and left edges were 3.7 and 3.6 mm, respectively, according to the lower-limit value of the epiglottitis group (Figure 1, A and C). Figures 2 and 3 show sonograms from a healthy volunteer and a patient with acute epiglottitis, respectively.

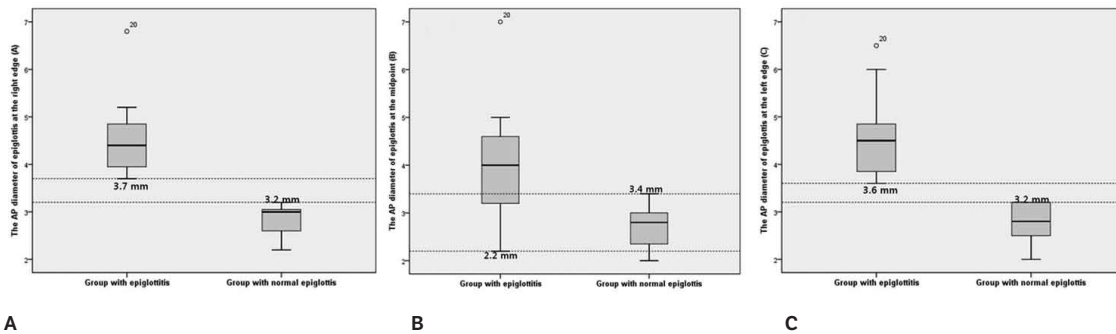
## Discussion

Recently, sonography has become available in most EDs. Bedside sonography is easy to perform and can accurately evaluate the status of unstable patients in EDs.<sup>5</sup> It may prove to be a rapid, noninvasive, and effective diagnostic tool for identifying and measuring the epiglottis.<sup>2</sup> Although the incidence of acute epiglottitis is very rare, the disease can be progressive and life threatening; therefore, early and safe diagnosis is required.<sup>1,2,5</sup> Conventional radiography cannot usually be performed on critically unstable patients in the intensive care unit or even in the ED. Additionally, it is difficult to obtain appropriate images of a patient with severe dyspnea. The diagnostic performance of conventional radiography is not satisfactory. Ng et al<sup>8</sup> reported that the “thumb sign” was present in only 77% of patients

**Table 1.** Demographic Characteristics and Anteroposterior Diameters of the Patients With Epiglottitis and Healthy Volunteers

Characteristic	Patients With Epiglottitis (n = 15)	Healthy Volunteers (n = 15)	P
Male/Female	8/7	9/6	.713
Age, y	43.0 ± 13.7	42.6 ± 16.9	.950
Height, cm	168.0 ± 6.7	169.7 ± 6.9	.489
Weight, kg	65.1 ± 12.1	64.5 ± 14.7	.868
Diameter, mm			
Right edge	4.5 ± 0.9 (3.7–6.8)	2.8 ± 0.3 (2.2–3.2)	<.001
Midpoint	4.0 ± 1.2 (2.2–6.8)	2.7 ± 0.4 (2.0–3.4)	<.001
Left edge	4.5 ± 0.8 (3.6–6.5)	2.8 ± 0.4 (2.0–3.2)	<.001

Values are mean ± SD and (range) where applicable.



**Figure 1.** Anteroposterior (AP) diameter of the epiglottis at the midpoint (**B**) and both edges (**A** on the right and **C** on the left relative to the patient) in the epiglottitis and control groups.

in their study, and the “vallecula sign” was identified in only 1 patient in which lateral neck radiography was performed. Stankiewicz et al<sup>9</sup> showed that lateral radiography had sensitivity of 38% and specificity of 76% for diagnosing epiglottitis.

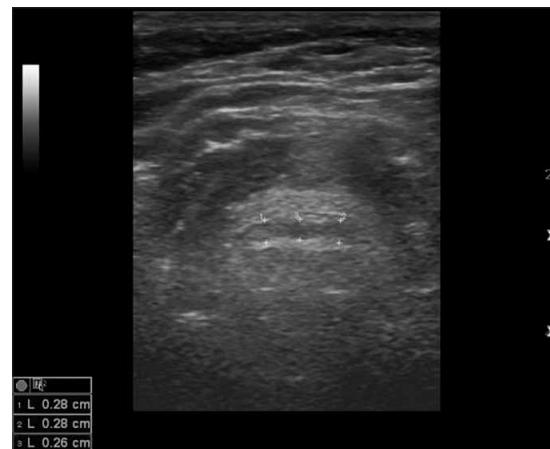
Indirect laryngoscopy is the method of choice for diagnosing acute epiglottitis; this technique is preferable to neck radiology.<sup>10</sup> However, indirect laryngoscopy can be invasive and may be inconvenient and painful for patients. Physicians with experience and special training in laryngoscopy are necessary for performing procedures to directly visualize and diagnose epiglottitis.<sup>11</sup> Werner et al<sup>2</sup> reported that the average thickness of the epiglottis in healthy adults was  $2.39 \pm 15$  mm ( $2.49 \pm 0.14$  mm in men and  $2.34 \pm 0.13$  mm in women), and Paik et al<sup>12</sup> reported that the average thickness was  $2.31 \pm 0.22$  mm ( $2.41 \pm 0.21$  mm in men and  $2.21 \pm 0.18$  mm in women); there was not much difference in the thickness. These results are comparable to our findings, in which the average thickness of the epiglottis at the midpoint in the control group was  $2.74 \pm 0.46$  mm.<sup>12</sup>

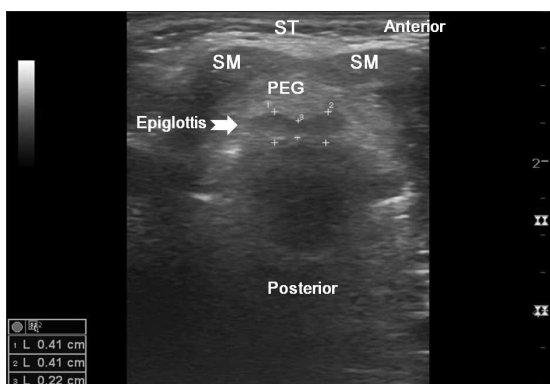
This study revealed a significant difference in the anteroposterior diameter of the three points of the epiglottis between the epiglottitis and control groups. However, there was an overlap in the range of thickness for the midpoint between the two groups. The measurement of the midpoint of the epiglottis may not be the optimal discriminator of epiglottitis. Nevertheless, no overlap was observed in the anteroposterior diameter of the epiglottis at both lateral edges (right and left) between the epiglottitis and control groups. Therefore, the anteroposterior diameter at both lateral edges may have usefulness as a discriminator for evaluating epiglottitis. These anatomic characteristics may prove useful for diagnosing an enlarged epiglottis, which is frequently observed in cases

of acute epiglottitis. Bedside sonography for evaluating the epiglottis can be performed on patients in a seated position. This aspect is useful because symptoms of dyspnea may be aggravated when patients are in a supine position. Therefore, sonography can be particularly useful for diagnosing acute epiglottitis in patients with dyspnea.<sup>12</sup>

This study had several limitations. First, the accuracy and diagnostic ability of sonography are dependent on the experience of the operator. Second, there was a significant difference without overlap between the thickness of the epiglottis at both edges in the patients with acute epiglottitis and the healthy volunteers. Therefore, in the future, diagnostic performance should be evaluated between patients with acute epiglottitis and those with symptoms of other upper airway infections, such as acute

**Figure 2.** Anteroposterior diameter of the epiglottis at the midpoint (3) and both edges (1 on the right and 2 on the left relative to the patient) in a transverse view from a healthy volunteer.





**Figure 3.** Anteroposterior diameter of the epiglottis at the midpoint (3) and both edges (1 on the right and 2 on the left relative to the patient) in a transverse view from a patient with a final diagnosis of acute epiglottitis. PEG indicates pre-epiglottic space; SM, strap muscles; and ST, soft tissue.

tonsillopharyngitis and deep neck infections. Third, a relatively small number of participants were included in our study. However, to our knowledge, there have been no other studies comparing sonograms of the normal epiglottis and acute epiglottitis. Additionally, the observed measurements of the epiglottis with epiglottitis compared to the normal epiglottis may be valuable for diagnosing epiglottitis. Therefore, our investigation could be seen as a pilot study for identifying and diagnosing epiglottitis with sonography in the ED. In the future, a prospective study with a larger number of patients will be needed to investigate the effectiveness of sonography in diagnosing acute epiglottitis.

In conclusion, the anteroposterior diameter of the epiglottis was significantly different between the patients with epiglottitis and the healthy control group. Because of this significant difference in the anteroposterior diameter of the epiglottis, sonography can be used as a rapid, non-invasive, and effective diagnostic tool for identifying cases of epiglottitis in the ED.

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