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Airway intervention in cases of acute epiglottitis

Y. Shimizu[1], E. Mori[1,3], K. Wada[2], N. Otori[3] and H. Kojima[3]

[1]Department of Otorhinolaryngology, The Jikei University Daisan Hospital, 4-11-1 Izumihoncho, Komae-shi, Tokyo 201-0003, Japan; [2]Department of Otorhinolaryngology, Toho University Omori Medical Center, 6-11-1 Omorinishi, Ota-ku, Tokyo 143-8541, Japan; [3]Department of Otorhinolaryngology, The Jikei University School of Medicine, 3-25-8 Nishishinbashi, Minato-ku, Tokyo 105-8461, Japan

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Abstract. *Airway intervention in cases of acute epiglottitis. Problem/objectives:* In cases of acute epiglottitis, indications for airway intervention have not been established. In the present study, we reviewed patients with acute epiglottitis to identify clinical factors, which suggest airway intervention should be performed.
Methodology: Patients with acute epiglottitis admitted to The Jikei University Daisan Hospital (Tokyo) from 2004 to 2013 were identified. Patients' characteristics, histories, laryngoscopic findings and laboratory findings were reviewed and analysed.
Results: Of the 83 patients (82 adults and one adolescent) in the sample, 16 (19%) underwent airway intervention and conservative treatment. The factors that were significantly more likely to have been present in patients who received airway intervention were odynophagia, drooling, hoarseness, muffled voice, dyspnoea, swelling of the posterior side of the epiglottis, less than 50% of the glottis area being visible with laryngoscopy, and a high white blood cell (WBC) count. The only factor that was shown by multiple logistic regression analysis to be distinctively predictive of airway intervention was "less than 50% of the glottis area being visible" (P = .000, odds ratio = 23.630, sensitivity = 86.6%, specificity = 78.6%, predictive accuracy = 85.2%).
Conclusions: When considering whether airway intervention should be performed in cases of acute epiglottitis, the most important clinical factor is the laryngoscopic finding that "less than 50% of the glottis area being visible." Other important clinical factors to consider are odynophagia, drooling, hoarseness, muffled voice, dyspnoea, swelling of the posterior side of the epiglottis and a high WBC count.

Introduction

Acute epiglottitis is a potentially life-threatening condition, which can quickly cause airway obstruction. Its most common cause is believed to be bacteria, but after the *Haemophilus influenzae* type B vaccine was introduced, acute epiglottitis has developed in fewer children.[1,2]

In Japan, persons with a sore throat usually consult an otolaryngologist. If acute epiglottitis is diagnosed with flexible laryngoscopy, the treatment chosen is either conservative treatment or airway intervention. Although the choice of treatment is usually simple (conservative treatment for mild swelling and airway intervention for severe swelling and symptoms), the severity of the swelling and other symptoms can be difficult to determine.

In Japan, acute epiglottitis has an estimated incidence of 11.4 cases per 100,000 persons a year[3] and an estimated mortality rate of 1.4%.[4] The incidence of acute epiglottitis is lower in some other countries (4.73 cases in Finland[5] and 2.02 cases in Canada[6]), although the mortality rate is similar (0.89% in the USA[1] and 1.2% in Canada[6]). Although physicians treating patients with acute epiglottitis should determine whether or not to perform airway intervention, its indications have not been established. The optimal method of airway management remains a controversial aspect of treating epiglottitis.[7] Therefore, to identify clinical factors that are more likely to be present in patients later undergoing airway intervention, which might, therefore, suggest that airway intervention should be performed, we retrospectively studied 83 patients with acute epiglottitis who were treated during a period of nine years.

Materials and methods

This study was approved by the ethics committee of The Jikei Institutional Review Board and by the clinical study committee of The Jikei University Daisan Hospital in Tokyo. We reviewed 83 patients (82 adults and one adolescent) with acute

epiglottitis who had been admitted to The Jikei University Daisan Hospital from January 2004 to August 2013. All cases of acute epiglottitis had been diagnosed with flexible laryngoscopy.

We collected data from hospital records and divided the patients into two treatment groups: those who had received only conservative treatment and those who had undergone airway intervention and conservative treatment. The treatments had been chosen by the physicians in charge of care after they had thoroughly assessed the patients and their conditions. We compared the treatment groups and performed multiple logistic regression analysis to identify factors that were more likely to have been present in patients before they had undergone airway intervention. Cases of acute epiglottitis were excluded if they were thought to be secondary oedema of the supraglottis, complicated by peritonsillar abscesses or deep neck abscesses, given that cases of secondary oedema of the supraglottis vary in treatment depending on the cause.

Background factors

The following were evaluated as possible background factors for the development of acute epiglottitis: sex, age, height, weight, body mass index, smoking, history of hypertension and diabetes mellitus, the number of days from symptom onset to examination at the hospital, and the history of treatment before examination at the hospital.

Symptoms

The presence of the following nine symptoms of acute epiglottitis was evaluated: fever (temperature ≥ 37.0˚C), sore throat, odynophagia, dysphagia, drooling, hoarseness, stridor, muffled voice and dyspnoea.

Flexible laryngoscopic findings

Flexible laryngoscopy was performed on all patients, while sitting with their chin raised, by an otolaryngologist. The larynx was evaluated from above the epiglottis. This position and procedure are standard in the hospital. Swelling was evaluated separately in the anterior and posterior sides of the epiglottis and the arytenoid(s). We investigated the percentage of cases in which less than 50% of the glottis area could be observed with flexible laryngoscopy (Figure 1).

Laboratory results

The mean WBC count and the C-reactive protein concentration were examined as laboratory results.

Analysis

All analysis was performed with the SPSS for Windows 11.0 J program (SPSS Japan, Tokyo, Japan). We compared the groups of patients by means of the Mann-Whitney test or the chi-square test. For example, the scores for each symptom were compared by means of the chi-square test. To

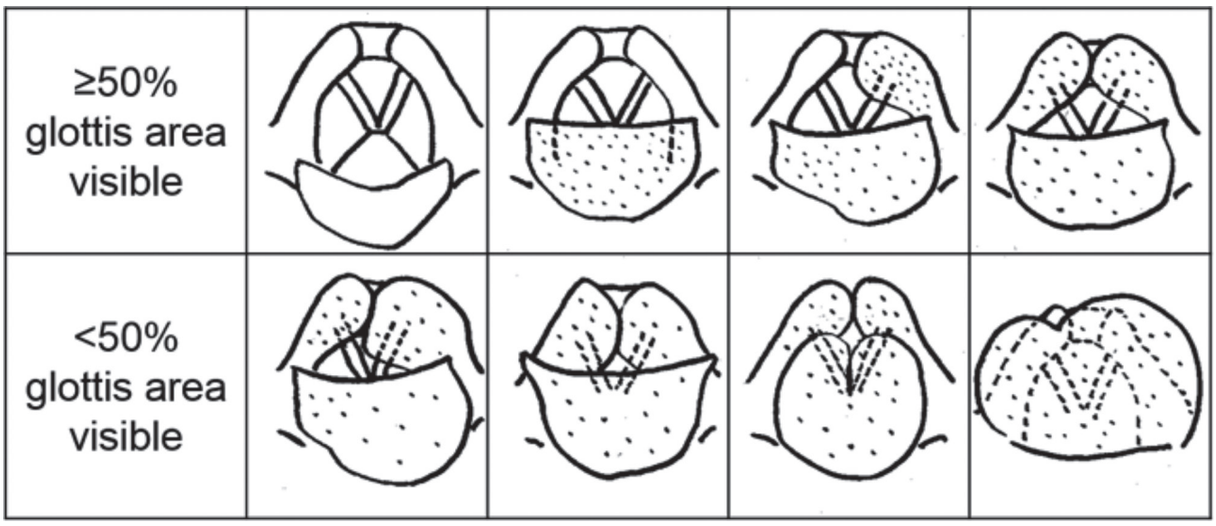

Figure 1
Examples of the visible glottis area

Table 1

Background factors were compared between two treatment groups by means of the Mann-Whitney test or the chi-square test (*)

Background factor	Overall (n = 83)	Airway intervention group (n = 16)	Conservative treatment group (n = 67)	*P* value
Sex (male:female)*	53:30	11:5	42:25	.650
Age (years)	50.4 ± 16.0	55.3 ± 15.1	49.2 ± 16.1	.175
Height (m)	1.65 ± 0.09	1.65 ± 0.10	1.65 ± 0.09	.703
Weight (kg)	64.0 ± 14.3	66.4 ± 17.5	63.4 ± 13.5	.949
Body mass index (kg/m^2)	23.4 ± 3.90	24.1 ± 4.83	23.2 ± 3.70	.657
Smoking*	26 (31.3%)	6 (37.5%)	20 (29.9%)	.579
Hypertension *	11 (13.3%)	3 (18.7%)	8 (11.9%)	.473
Diabetes mellitus*	5 (6.0%)	1 (6.7%)	4 (6.0%)	.966
Days from onset to examination	2.18 ± 2.15	2.00 ± 2.60	2.20 ± 2.00	.208
Treatment before examination*	11 (13.3%)	1 (6.3%)	10 (14.9%)	.358

evaluate factors suggesting that airway intervention should be performed, we performed multiple logistic regression analysis of the significant findings. A finding was considered significant if $P < .05$.

Results

Number of patients undergoing airway intervention

Both airway intervention and conservative treatment were performed on 16 (19%) of the 83 patients: in 15 patients (18%), the intervention was tracheotomy by an otolaryngologists, while, in one patient (1%), the intervention was intubation by an internist. Airway intervention was performed on the day of admission for 12 of the 16 patients and on the day after admission for the other four patients, because the swelling had increased despite conservative treatment. Conservative treatment alone, with antibiotics and intravenous corticosteroids, was performed on the remaining 67 patients (81%).

None of the 83 patients died during hospitalization. One patient was discharged with the complication of hypoxic encephalopathy, although emergency tracheotomy was performed. The other 82 patients were discharged without complications.

Background factors

Of the background factors we examined, none differed significantly between patients who received airway intervention and those who received only conservative treatment (Table 1).

The patients ranged in age from 14 to 80 years. One patient was younger than 18 years (aged 14 years) and received only conservative treatment.

Symptoms

Patients who received airway intervention were significantly more likely to have been admitted with odynophagia and to have presented with drooling, hoarseness, muffled voice or dyspnoea (chi-square test $P < .05$) (Table 2). However, even among these patients, the percentage of those with any symptom, except odynophagia, was less than 50%.

Flexible laryngoscopic findings

Both swelling of the posterior side of the epiglottis and visibility of less than 50% of the glottis area were present in a significantly greater percentage of patients who underwent airway intervention (21.4% and 81.3%, respectively) than of patients who received only conservative treatment (3.0% and 13.4%, respectively; chi-square test $P < .05$) (Table 3).

Laboratory results

The mean WBC count was significantly greater in patients receiving airway intervention than in patients receiving only conservative treatment (Table 3). In contrast, the mean C-reactive protein concentration did not differ significantly between

patients receiving airway intervention and patients receiving only conservative treatment.

Multiple logistic regression analysis of factors

In patients who underwent airway intervention, five factors (odynophagia, drooling, hoarseness, muffled voice and dyspnoea) were significantly more likely to have been present, two factors (swelling of the posterior side of the epiglottis and less than 50% of the glottis area being visible) were significantly more likely to have been found with flexible laryngoscopy, and one factor (mean WBC count) was significantly more likely to have been higher on laboratory studies than in patients who received only conservative therapy. However, only one of these eight factors (less than 50% of the glottis area being visible) was found, with the use of multiple logistic regression analysis, to significantly increase the probability of airway intervention (P = .000, odds ratio = 23.630, 95% confidence interval = 5.504–101.441, sensitivity = 86.6%, specificity = 78.6%, predictive accuracy = 85.2%).

Discussion

Among patients who have acute epiglottitis, the percentage treated with airway intervention has been between 8% and 20% in previous studies[1,5,6,8,9]; it was 19% in the present study. Although intubation is the type of airway intervention more commonly performed in Western countries,[1,9] tracheotomy is more commonly performed in Japan.[8,10] In the present study, tracheotomy was performed on 93.8% of patients who underwent airway intervention. The apparent reason that tracheotomy is the more performed airway intervention in Japan is that the airway is consecutively narrowed and becomes suddenly obstructed if a failure of intubation enhances the swelling of the epiglottis,[8,10] as well as if sedatives administered for intubation sink the root of the tongue. The male-to-female distribution ratio ranged from 1.5:1 to 2:1 in previous studies [1,5,8] and was similar in the present study (1.8:1).

Of the patients with acute epiglottitis in the present study (mean age: 50.4 years), only one patient (1.2%) was younger than 18 years. Some reports[1,2,11] state that acute epiglottitis has recently become more common in adults than in children. However, children in our region of Tokyo who require emergency care for acute epiglottitis tend to be sent to a paediatric medicine centre near our hospital, rather than to the hospital itself. Furthermore, we presume that the patients in our study were not affected by the *Haemophilus influenzae* type B vaccine because it only became mandatory in Japan in 2013 for children aged two months to five years.

Assuming that obesity could contribute to airway obstruction, we compared height, weight and body mass index among patients who received airway intervention and those who received only conservative treatment; however, we observed no statistical differences among these factors.

Several studies have found that airway intervention is related to diabetes mellitus,[5,8,12] but the present study found no significant difference

Table 2

Symptoms were compared between two treatment groups by means of the chi-square test

Symptom	Overall (n = 83)	Airway intervention group (n = 16)	Conservative treatment group (n = 67)	*P* value
Fever (≥ 37.0˚C)	47 of 82 (56.6%)	11 (68.8%)	36 of 66 (54.5%)	.303
Sore throat	83 (100%)	16 (100%)	67 (100%)	-
Odynophagia	54 (65.1%)	14 (87.5%)	40 (59.7%)	.036
Dysphagia	47 (56.6%)	12 (75.0%)	35 (52.2%)	.099
Drooling	1 (1.2%)	1 (6.3%)	0 (0%)	.040
Hoarseness	9 (10.8%)	5 (31.3%)	4 (6.0%)	.003
Stridor	0 (0%)	0 (0%)	0 (0%)	-
Muffled voice	4 (5.0%)	3 (18.8%)	1 (1.5%)	.004
Dyspnoea	13 (15.7%)	8 (50%)	5 (7.5%)	.000

Table 3

Flexible laryngoscopic findings and laboratory results were compared between two treatment groups by means of the Mann Whitney test or the chi-square test (*)

	Overall (n = 83)	Airway intervention group (n = 16)	Conservative treatment group (n = 67)	*P* value
Swelling of anterior side of epiglottis*	83 (100%)	16 (100%)	67 (100%)	-
Swelling of posterior side of epiglottis*	5 of 81 (6.0%)	3 of 14 (21.4%)	2 (3.0%)	.009
Swelling of arytenoid(s)*	48 of 81 (59.3%)	10 of 14 (71.4%)	38 (56.7%)	.308
Less than 50% of glottis area visible*	22 (26.5%)	13 (81.3%)	9 (13.4%)	.000
Mean WBC count (cells/mm^3)	13,266.9 ± 5,060.4	16,771.9 ± 6,624.3	12,430.0 ± 4,260.6	.022
C-reactive protein concentration (mg/dl)	5.54 ± 6.13	8.71 ± 9.59	4.78 ± 4.75	.562

in diabetes mellitus between the treatment groups. We also found no significant difference in the rate of hypertension. However, we were not able to compare cases on the basis of hyperlipidaemia because few patients had undergone a lipid examination.

Although rapid onset, defined as symptoms being present for no more than 24 hours before a physician is consulted, was reported as being an indication for airway intervention,[4,6,8,12] its presence did not differ significantly between groups of patients in the present study. We consider this lack of difference to be a possible reason why some patients came early to the hospital with slight symptoms, whereas others came late with severe symptoms. Of course, how soon a patient with severe symptoms comes to a hospital depends on both the patient's judgement and the type of hospital. A previous study has found that, when symptoms are present for longer before diagnosis, airway intervention is more likely to be needed; this relationship might be due to the delayed diagnosis causing the inflammation of the supraglottic tissue to be more severe.[5]

Patients who received airway intervention were significantly more likely to be admitted with odynophagia, drooling, hoarseness, muffled voice and dyspnoea. Therefore, we consider these symptoms to be factors suggesting that airway intervention should be performed. However, judging that the risk of airway obstruction is low, even if the significant factors are not present, is inappropriate, because symptoms other than odynophagia were present in less than 50% of patients, including those who underwent airway intervention. Several studies have reported the following symptoms as being related to the need for airway intervention: stridor and respiratory distress;[9] drooling, stridor/dyspnoea and muffled voice;[12] dyspnoea during admission;[6] stridor and sitting erect.[13] Although no patients in the present study were admitted with the diagnosis of stridor, we believe that some patients had cases of stridor, which were recorded instead as "dyspnoea" or were simply not recorded at all.

The airway of the larynx is surrounded by the epiglottis, aryepiglottic folds, arytenoids, interarytenoid area, false vocal cords and true vocal cords. Inflammatory oedema of acute epiglottitis usually appears first on the anterior side of the epiglottis and then spreads to the aryepiglottic fold(s) and arytenoid(s). The false vocal cord(s) and the posterior side of the epiglottis appear to swell when the inflammation is severe. Although the percentage of the observable glottis area was used in a previous study to evaluate the swelling of the epiglottis alone,[8] we evaluated the area by including swelling in the false vocal cords, arytenoids, aryepiglottic folds and epiglottis. Swelling of the posterior side of the epiglottis and the "less than 50% of the glottis area being visible" factor were significantly more common as laryngoscopic findings in patients who underwent airway intervention. Therefore, these findings should also be considered as factors suggesting the necessity for airway intervention.

The WBC count was found to be significantly higher in patients who received airway

intervention. Therefore, a high WBC count should also be considered a factor suggesting that airway intervention should be performed, given that a previous study found that WBC counts are significantly higher in patients who receive tracheotomy than in patients who receive only conservative treatment.[14]

History, symptoms, laryngoscopic findings and laboratory findings have been presented in previous studies as indications for airway intervention,[4,6,8,9,11-17] but all factors are not simultaneously present. In addition, the present study found that, of the indicative factors, only "less than 50% of the glottis area being visible" was distinctively predictive of the patient later undergoing airway intervention (predictive accuracy = 85.2%).

The significant findings of this study are the factors, which are more likely to be present in patients who later undergo airway intervention, although it is impossible to know whether airway obstruction should be considered necessary unless airway intervention was performed. However, we believe these statistically significant results can be a reference for physicians to decide what treatment to perform on patients with acute epiglottitis, given that many physicians in the previous nine years individually made decisions on treatment despite having no guidelines.

Conclusion

On the basis of our present findings, we believe that whether or not airway intervention is performed on patients with epiglottitis must be determined through a careful consideration of many factors. First, the laryngoscopic finding of "less than 50% of the glottis area being visible" should be considered to strongly suggest the necessity for airway intervention. Second, the symptoms of odynophagia, drooling, hoarseness, muffled voice, dyspnoea, swelling of the posterior side of the epiglottis and a high WBC count should also be considered factors, which suggest that airway intervention should be performed.

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Yuta Shimizu, MD, Department of Otorhinolaryngology,
The Jikei University Daisan Hospital, 4-11-1 Izumihoncho,
Komae-shi
Tokyo 201-0003
Japan
E_mail: yuta-shimizu@jikei.ac.jp
Tel: +81-3-3480-1151
Fax: +81-3-3430-3611