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Airway Management for Adult Patients with Acute Epiglottitis

A 12-year Experience at an Academic Medical Center (1984-1995)

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RECENT surveys of cases of acute epiglottitis demonstrate that acute epiglottitis is becoming a rare disease in children and is being encountered or reported predominantly among adults.[1,2] In the state of Rhode Island, the incidence in children declined from 38 cases in 1975-1977 to a single case in 1990-1992. In contrast, the incidence in adults increased from 17 in 1975-1977 to 69 in 1990-1992.[1] The reason for this decline in children is believed to be due to effective vaccination against *Hemophilus influenzae,* the most common bacterial pathogen implicated in epiglottitis. One suggested reason for the increased incidence in adults is that the frequent use of antibiotic agents in childhood may be associated with failure to develop immunity to *H. influenzae.*[3] Most of the increase is not due to a greater number of cases caused by *H. influenzae,* however, and greater awareness and recognition of the disease in adults may have played a role.[1] In addition, cases of epiglottitis caused by unusual pathogens are being reported among the immunocompromised individuals[4,5] and drug abusers.[6]

There is no consensus on the optimal management of adult patients with acute epiglottitis. Whereas it is agreed that patients presenting with imminent or actual airway obstruction should have an artificial airway placed immediately, airway management for adult patients presenting with mild to moderate or no respiratory symptoms is controversial. At one extreme, some authors maintain that, because there are no reliable predictors of sudden and fatal airway obstruction in epiglottitis, all patients with epiglottitis should get an artificial airway at the time of presentation.[7-9] At the other extreme, some advocate only conservative medical management with vigilant monitoring, whether patients have moderate respiratory symptoms or not.[10-12] The remaining authors recommend elective intubation in a controlled setting for adult patients who present with mild to moderate symptoms or signs of respiratory distress.[1,13-20] This recommendation is based on the observation that adults with epiglottitis who present with mild to moderate respiratory distress have a chance as great as 18% of subsequently developing a complete airway obstruction.[13] Even among the latter group of authors, however, the symptom(s) and sign(s) of respiratory distress that constitute the criteria for placement of an artificial airway remain a matter of debate. Whereas Kass *et al.*[17] have found that stridor is the only reliable predictor of airway intervention, Deeb *et al.*[20] found drooling and acute presentation within 8 h of symptom onset to be predictive. Others[1,13,19] consider various combinations of risk factors, such as stridor, drooling, acute onset or rapid progression, hoarseness, respiratory rate >20 breaths/min, dyspnea, chest wall retractions, and upright position.

In this study, we reviewed the experience at Beth Israel Hospital (Boston, Massachusetts) with managing adult epiglottitis from 1984-1995. Particular attention was paid to airway management, morbidity and mortal-

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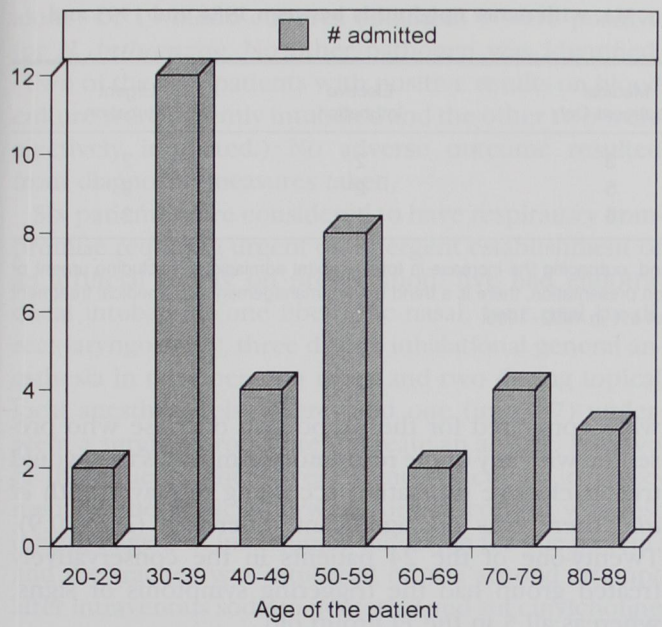

Fig. 1. Patient age groups.

ity, and cost of hospitalization. Further, we wished to determined whether our experience would confirm the recently reported increased incidence.

Methods

Database

In accordance with the standards of the institutional Committee on Clinical Investigations, the in-hospital registry of admission diagnoses was reviewed from 1984-1995 to identify patient records with a primary or secondary diagnosis at admission of acute epiglottitis. The Beth Israel Hospital has a computerized registry of all admissions with listings of diagnoses at admission. During this period, the Beth Israel Hospital was a major university-affiliated tertiary medical care center with 508 adult inpatient beds. The diagnosis of acute epiglottitis was considered confirmed by positive findings on laryngoscopy or soft-tissue radiography of the neck in an appropriate clinical setting.[1] Of 36 patients identified on the computer search, 1 was judged to represent a misdiagnosis. The remaining 35 records are the subject of this study. Each patient record was reviewed for demographic variables, clinical presentation, treatment modality, airway management, length of hospitalization, and outcome. Information on hospitalization charges was obtained from hospital billing records, and dollar amounts were adjusted to 1995 figures, using the consumer price index for Boston for 1984-1995.§

Definition of Types of Airway Management

Patients who presented with imminent or actual airway obstruction and required immediate endotracheal intubation or surgical airway were grouped into the category "urgent intubation" (UI). Those who were intubated despite lack of imminent airway obstruction at the time of presentation were grouped into the category "elective intubation" (EI), whether or not they had signs or symptoms of mild to moderate respiratory distress. The rest of the patients were in the group "medical Rx only" (MRO).

Statistical Analysis

Fisher's exact test (two-tailed) was used to compare two proportions. The Monte Carlo randomization test (two-tailed) was used to compare more than two proportions. These nonparametric tests comparing proportions are considered superior to the chi-square test when the sample size is small for one or more of the boxes in contingency tables. Student's *t* test (two-tailed) was used to compare the means of two populations where appropriate. A probability value <0.05 was considered significant. All statistics were calculated using True Epistat® software (Epistat Services, Richardson, TX).

Results

Demographics

All adult age groups of patients were represented, with a range of 21-87 yr, a median age of 47 yr, a mean age of 50 yr, and possibly a mode in the 30-39-yr-old age group with 12 patients (fig. 1). Twenty-five patients were men, and 10 were women. There appeared to be no seasonal predilection, with 7 cases in spring, 9 in summer, 9 in autumn, and 10 in winter. There were 7 admissions with acute epiglottitis in the first 4-yr period (1984-1987), 9 in the next 4 yr, and 19 in the last 4 yr (table 1).

Clinical Presentation and Treatment

The incidence of presenting symptoms and signs is outlined in table 2. Sore throat and dysphagia were

§ As published by the Bureau of Labor Statistics on the internet at http://stats.bls.gov:80/cgi-bin/surveymost.

Table 1. Number of Adults Admitted to Beth Israel Hospital, Boston, MA, with Acute Epiglottitis between 1984 and 1995 and Their Treatment Modality

Years	No. Admitted (% of total admissions)	Medical Treatment Only	Elective Intubation	Urgent Intubation
1984–1987	7 (0.007%)	3	2	2
1988–1991	9 (0.008%)	5	2	2
1992–1995	19 (0.016%)	16	1	2

Admissions with acute epiglottitis showed an increasing trend over the study period, outpacing the increase in total hospital admissions. Excluding urgent or emergent establishment of an artificial airway because of respiratory compromise on presentation, there is a trend toward management with medical treatment alone. Incidence of elective intubation decreased from 40% in 1984–1987 to about 6% in 1992–1995.

reported in most patients, whereas about half demonstrated fever and respiratory difficulty. More than 80% presented later than 24 h after appearance of initial symptoms. Among coexisting diseases, five reported hypertension, four had a seizure disorder, three had a history of alcohol abuse and two of other drug abuse, four had a history of cancer, and five were possibly immunocompromised (one had human immunodeficiency virus, one was undergoing long-term steroid therapy, two had lymphoma, and one had severe malnutrition/agranulocytosis).

The incidence of respiratory difficulty on presentation was higher in the UI group than in the MRO group. Otherwise, the incidence of the presenting symptoms or signs examined appeared similar among the three treatment groups. When the MRO and the EI groups were compared for the proportion of those who presented with any of the respiratory symptoms that would trigger elective intubation according to Mayo-Smith *et al.*,[1] there was no significant difference ($P > 0.9$). Twenty-one of the 24 patients in the conservatively treated group had the triggering symptoms or signs, whereas all 5 in the EI group did.

The diagnosis of epiglottitis was confirmed by laryngoscopy in 28 patients, indirectly in 26 (20 by fiberoptic nasopharyngolaryngoscopy) and directly in 2 at the time of urgent intubation. Of these 28 patients, 17 also had soft-tissue radiographs of the neck corroborating the diagnosis. In four patients, radiographic findings were interpreted as negative, despite positive findings on laryngoscopy. Diagnosis in seven patients was confirmed on the basis of positive findings on radiographs

Table 2. Incidence of Presenting Symptoms or Signs by Airway Management Modality Selected

Symptoms or Signs	Overall Incidence	Incidence by Airway Management		
		MRO	EI	UI
Sore throat	32/35	23/24	3/5	6/6
Dysphagia/odynophagia	30/35	21/24	4/5	5/6
Enlarged epiglottis on laryngoscopy or x-ray	26/35	18/24	3/5	5/6
Fever > 100°F	20/35	12/24	4/5	4/6
Respiratory difficulty (subjective symptoms only)	16/35 (5/35)	7/24 (3/24)	3/5 (2/5)	6/6* (0/6)
Drooling	10/35	7/24	2/5	1/6
Cough	9/35	4/24	2/5	3/6
Stridor	8/35	3/24	2/5	3/6
Presentation within 24 h of symptom onset	7/35	3/24	1/5	3/6
Neck tenderness or swelling	5/35	3/24	2/5	1/6

Presenting symptoms/signs were similar for the MRO (medical Rx only) and the EI (elective intubation) groups. The incidence of objective signs of respiratory difficulty in the UI (urgent intubation) group was higher than in the other groups. Values in parentheses indicate patients who had subjective symptoms of respiratory difficulty without any objective signs of respiratory difficulty.

* $P < 0.05$ *versus* MRO.

alone. Of 19 blood cultures obtained, 4 were positive for *H. influenzae.* No other pathogen was identified. (Two of the four patients with positive results on blood culture were urgently intubated and the other two were electively intubated.) No adverse outcome resulted from diagnostic measures taken.

Six patients were considered to have respiratory compromise requiring urgent or emergent establishment of an artificial airway on presentation: five had endotracheal intubation (one fiberoptic nasal, four oral by direct laryngoscopy; three during inhalational general anesthesia in the operating room and two during topical local anesthesia elsewhere) and one (in 1987) underwent a surgical procedure to create an airway. For two of the patients, there were some difficulties in placement of the artificial airway: Airway control was lost during stage II of inhalational induction for one patient, and the trachea was intubated on the second attempt after intravenous sodium pentothal and succinylcholine were given. For another patient, the oropharyngeal structures were unrecognizable because of edema and secretions, but the anesthesiologist "followed the bubbles" from the trachea to intubate it successfully. One of the six patients died of problems related to a coexisting disease (metastatic lymphoma). Another developed "steroid psychosis," but recovered. Each of the other four made an uneventful recovery.

For the remaining patients, there appeared to be an increasing trend over time toward management with conservative medical treatment alone (table 1; $P < 0.05$). Medical management consisted of administering antibiotic agents and supplemental oxygen as needed, with optional racemic epinephrine (5 of 35 patients), steroids (20 of 35), and analgesic agents. Most patients (22 of 35, including 17 of 19 in 1992–95) received second or third generation cephalosporins (cefuroxime, ceftazidime, ceftriaxone, or cefotaxime); the remainder were treated with a combination of ampicillin and chloramphenicol or with oxacillin/nafcillin and chloramphenicol or ampicillin alone.

Four of the five patients electively intubated (5 endotracheal tube, 0 surgical airway) had major complications: three had "ICU psychosis," one had hepatitis (possible halothane-related), and one had right lower lobe pneumonia 3 days after intubation. No medically treated patients sustained complications. Conservatively managed patients had shorter hospitalizations and lower hospitalization charges than either those who were electively intubated or those urgently intubated (table 3). All patients, regardless of group, recovered completely from their bout of acute epiglottitis. Because of zero mortality in the MRO and EI groups, the odds ratio or relative risk of mortality could not be calculated.

Discussion

Review of our experience from 1984–1995 demonstrated that routine prophylactic intubation of adult patients with acute epiglottitis does not appear to be necessary. We observed greater morbidity and longer hospitalization periods with elective creation of an artificial airway, but these differences may be due to undocumented differences in population characteristics between the EI and MRO groups. Our data also support the premise that hospital admissions for acute epiglottitis appeared to be increasing in the adult population under study during this period.

Our population of adult patients with acute epiglottitis appears comparable to those reported in other studies. All age groups were represented, possibly with a mode in the 30- to 39-yr-old age group, as also noted by other authors.[1,3,15,21] Our 2.5:1 male-to-female ratio corroborates male preponderance seen in other series,[1,3,14,15,17,20,22] although this was not seen in one smaller series.[21] Sore throat and dysphagia/odynophagia were the most common symptoms noted, as has been reported by virtually all authors.[1,3,7,12–15,17,20–27] The classic "muffled voice"[24] was observed infrequently by our physicians. Patients presenting within 24 h of symptom occurrence or with positive results on blood culture, who may have a more severe form of the disease,[1,27] represented <20% of our patients. Coexisting diseases appeared common in our population. It is noteworthy that patients with a history of drug or alcohol abuse or those who were possibly immunocompromised constituted a significant fraction (10 of 35). In the future, we speculate that this group may constitute an even greater proportion of cases of adult epiglottitis. Review of the literature (table 4) reveals mortality from adult epiglottitis of about 1%, including patients presenting with frank respiratory failure or arrest. In our modest-sized population, there was no mortality attributable to acute epiglottitis.

The rationale for early elective intubation before signs of airway obstruction occur[7–9] is lack of reliable criteria for discriminating, at presentation, patients who may sustain a sudden airway obstruction[28] from those whose course may be benign. A fraction of patients (*e.g.,* 13

Table 3. Number of Days of Hospitalization and Hospitalization Charges (in Thousands of Dollars) by Years and Treatment Modality

	Medical Treatment Only		Elective Intubation		Urgent Intubation	
Years	Days	Charges (thousands of dollars)	Days	Charges (thousands of dollars)	Days	Charges (thousands of dollars)
1984–1987	4.0 ± 1.6	4.1 ± 1.4	10 ± 6	12.1 ± 8.3	5.5 ± 0.5	6.4 ± 1.1
1988–1991	2.8 ± 1.3	3.0 ± 1.7	13 ± 5	23.1 ± 9.3	12.5 ± 5.5	24.9 ± 10.8
1992–1995	2.4 ± 1.0	4.4 ± 1.6	11	42.4	11.5 ± 4.5	33.7 ± 8.3
1984–1995	2.7 ± 1.3	4.0 ± 1.7	11.4 ± 5.1	22.6 ± 13.6	9.8 ± 5.1	21.6 ± 13.9

Data are mean ± SD.

Those who were conservatively treated had significantly shorter hospitalizations and lower hospitalization charges than those either electively or urgently intubated. In the period 1992–1995, one of the medical therapy patients was hospitalized for 30 days and charged $116,946.62 (in 1995 dollars) because of severe malnutrition/agranulocytosis, unrelated to acute epiglottitis. This patient was excluded in calculating the mean hospitalization and hospital cost. If this patient is included, then the days of hospitalization (and hospitalization charges in thousands of dollars in parentheses) for the conservatively treated group are 4.1 ± 6.7 (11.4 ± 27.3) for 1992–1995 and 3.8 ± 5.6 (8.7 ± 22.6) for the entire study period.

of 240 in the study by Mayo-Smith *et al.*,[1] 12 of 143 in the study by Andreassen *et al.*,[23] 1 of 29 in the study by Dort *et al.*,[15] 0 of 110 in the study by Frantz *et al.*,[14] and 0 of 24 in our study) who initially receive medical management alone may develop signs of airway compromise and be deemed to require an artificial airway. Some of them may not receive an artificial airway in a timely manner and potentially may experience serious morbidity or die. Conversely, elective intubation in patients with acute epiglottitis is not benign and is associ-

Table 4. Mortality Rates of Acute Epiglottitis in Adults by Treatment Modality, as Reported in the Literature and in the Present Study

Reference	Years	Total No. of Patients	Mortality (total)	Mortality (medical treatment only)	Mortality (elective airway)
Hawkins *et al.*[3]	1963–1972	17	0/17	0/13	0/4
Andreassen *et al.*[23]	1965–1991	168	2/168	0/143	0/20
de Souza *et al.*[24]	1973–1974	10	2/10	Unspecified	Unspecified
Arndal *et al.*[10]	1974–1985	49	0/49	0/46	0/0
Deeb *et al.*[20]	1975–1982	80	0/80	0/56	0/24
Friedman *et al.*[19]	1975–1985	20	2/20	2/20	0/0
Mayo-Smith *et al.*[1]	1975–1992	273	9/273	3/240	1/23
Ossoff *et al.*[21]	1978–1979	15	0/15	0/12	0/3
Wolf *et al.*[11]	1978–1987	30	0/30	0/30	0/0
Navarrete *et al.*[22]	1979–1990	49	0/49	0/43	0/6
Bishop[7]	1980	5	0/5	0/1	0/4
Torkkeli *et al.*[12]	1981–1992	32	0/32	0/27	0/1
Shapiro *et al.*[27]	1982–1983	8	0/8	0/8	0/0
Dort *et al.*[15]	1982–1992	43	0/43*	0/29	0/14
Crosby and Reid[13]	1983–1989	21	0/21	0/18	0/0
Love *et al.*[25]	1984	5	1/5	0/2	1/3
Warshawski *et al.*[26]	1986	5	0/5	0/2	0/3
Frantz *et al.*[14]	1986–1991	129	0/129	0/110	0/19
Kass *et al.*[17]	1987–1990	17	0/17	0/15	0/1
Park *et al.* (current study)	1984–1995	35	0/35*	0/24	0/5
Total	1963–1995	1,011	16/1,011	5/829	2/130

Total N exceeds the sum of N for conservative medical management and N for elective intubation, since the total N includes those who required an artificial airway urgently or emergently.

* One patient died from a cause unrelated to acute epiglottitis.

ated with a tangible risk for mortality and morbidity. Love *et al.*[25] reported a patient with acute epiglottitis who developed airway obstruction on induction of general anesthesia and subsequently died of respiratory failure. Loss of tone of airway muscles on induction of anesthesia may have contributed to airway obstruction in the patient. Andreassen *et al.*[23] reported that 4 of the 20 patients with acute epiglottitis who electively received an artificial airway turned out to be impossible to intubate laryngoscopically and required emergency tracheostomies. Difficult intubation followed by failure to secure even a surgically created airway may lead to death. Inhalational induction in an adult patient may be associated with a relatively long excitement stage and may lead to problems with arrhythmias and aspiration. Even when a fiberoptic intubation is attempted on an awake, suitably cooperative, and tolerant patient, morbidity may result from (1) inadequate topical anesthesia, (2) injudicious use of sedation, and (3) the fact that passage of the bronchoscope through the larynx may completely occlude an already narrowed airway, precipitating a (temporary) airway obstruction.[29] This necessitates blind telescoping of an endotracheal tube past a friable epiglottis/supraglottic area and into the trachea, potentially causing hemorrhage and fragmentation of the epiglottis. Consequently, the occasional mortality associated with managing epiglottitis initially by a medical regimen alone may well not exceed that of elective intubation in addition to medical treatment. We would also emphasize, however, that conservative medical management should always be accompanied by vigilant monitoring for possible respiratory compromise and by maintenance of a low threshold to intervene with an artificial airway in patients whose respiratory symptoms worsen despite medical management. According to Friedman *et al.*,[19] it is precisely such patients who suffer mortality on conservative medical management.

Longer hospitalization with elective intubation has been noted previously by others.[14,15,17,20,23] In our series, patients who were electively intubated experienced longer hospitalization and greater morbidity than patients treated conservatively. We cannot rule out the possibility that both were due to differences in the characteristics of the patients composing these groups. Application of an intubation algorithm such as that of Mayo-Smith *et al.*[1] would have led to unnecessary and potentially morbid and costly intubation and an intensive care unit stay in 21 of our 24 conservatively managed patients. Although our chart review of presenting symptoms and signs appeared to be similar for the MRO and EI groups, we cannot rule out undocumented differences between the groups leading the on-site clinicians to favor elective intubation in some patients. It is noteworthy that two of the electively intubated patients had blood cultures positive for *H. influenzae,* whereas none of the conservatively treated patients did.

Limitations of Our Study

First, our study is a retrospective review. There was no randomized stratification of the patients into different treatment groups being compared. It is possible that different treatment groups might represent different patient populations with different severity of the disease. Although the incidence of presenting symptoms and signs appeared similar for the EI and the MRO groups, certain subtle differences between the groups might have been undocumented.

Second, our study reviews experience at a tertiary care medical center, where personnel experienced in airway management are always available. Whereas conservative treatment with vigilant monitoring may be feasible at such a medical center, it may not be applicable at a hospital where 24-h coverage by an anesthesiologist and an otolaryngologist may not be available.

Third, our study does not preclude the possibility that for a certain subset of patients, such as immunocompromised patients in whom epiglottitis may be rapidly progressive, conservative medical management may not be sufficient and early airway intervention may be indicated. Rothstein *et al.*[30] reported five cases of epiglottitis in patients with acquired immune deficiency syndrome (AIDS) who all required airway intervention either on presentation or after unsuccessful medical management. Medical management in such patients should include coverage of unusual opportunistic pathogens such as *Candida.*[4,31] In our series, of the five patients who were possibly immunocompromised, three were treated conservatively with uneventful recovery and two required urgent intubation, one of the two dying from complications of her coexisting disease (lymphoma).

Fourth, in our retrospective survey, diagnostic criteria were not uniform. Seven of the 35 patients were diagnosed by clinical presentation and radiographic findings alone without laryngoscopic confirmation. Although it is true that soft-tissue radiography of the neck is not a sensitive diagnostic tool for epiglottitis, it is nonetheless a very specific diagnostic test with a very low false-positive rate. In one study by Nemzek *et al.*,[32] the specificity of the test approached 100%. In addition, in the

clinical review of cases of epiglottitis by Mayo-Smith *et al.*,[1] diagnosis of epiglottitis was made if the patient had (1) a clinical picture characteristic of acute epiglottitis, and (2) a positive finding on laryngoscopy (direct or indirect), radiography, or autopsy. Their method of diagnosis reflects our practice pattern and, we suspect, the practice pattern in general. We submit that we were justified in including the seven patients in our review of epiglottitis.

Fifth, our sample size was small, especially for the EI and UI groups. A finding of zero mortality in a small sample does not imply a true population mortality of 0%.[33] Given a true mortality of x%, a zero incidence of mortality may be noted in a sample of size n at the rate of $(1 - x)^n$. Therefore, as n increases, the finding of zero incidence of mortality gains in confidence and power. At n = 24 (MRO group), zero incidence of mortality could be observed even if the true population mortality was as high as ≈12%[33]; at n = 5 (EI group), zero incidence of mortality could be observed even if the true population mortality was as high as 60%. Therefore, a relative risk of EI over MRO cannot be estimated from our data.

We report a 12-yr experience at the Beth Israel Hospital (Boston, MA) with managing adult patients with acute epiglottitis. In our population, there was an increasing incidence of acute epiglottitis in adults and a trend toward conservative medical management alone, except for in those patients with obvious respiratory compromise at initial presentation. For adult patients with acute epiglottitis without severe respiratory distress at presentation, routine prophylactic intubation appears unnecessary if observation facilities and personnel skilled in airway management are available.

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