Background: External laryngeal trauma (ELT) is a rare but clinically important injury.

Objective: To perform the first population-based, time series analysis of the epidemiology, management, and outcomes of ELT using an 11-state, inpatient sample database containing more than 54 million patients.

Patients: Three hundred ninety-two patients with a primary or secondary diagnosis of ELT were identified. Over a 5-year period, the incidence of ELT in this series was 1/137 000. The mean (±SD) age was 37 (±7) years, and the overall mortality rate was 2.04%. Two hundred forty-eight patients required surgical intervention.

Results: The average length of stay for 67 patients not requiring surgical intervention for any injury was 3 (±2) days, with no mortality. One hundred eighty patients underwent endoscopy, with 14 requiring tracheotomy alone and 57 requiring tracheotomy plus laryngeal repair. The average length of stay and the mortality rate were higher in these latter groups. Overall, 139 patients underwent tracheotomy, with a mortality rate of 5%, while 96 patients underwent laryngeal repair, with a mortality rate of 1%. Surgical treatment was performed in 140 patients with ELT within 24 hours after presentation, while another 60 received treatment within 48 hours. Associated injuries included skull base or intracranial injury (13%), open neck injury (9%), cervical spine injury (8%), and esophageal or pharyngeal injury (3%).

Conclusion: External laryngeal trauma is a rare injury, with most patients requiring surgical intervention.
mortality rate was 2.04%. There was an apparent trend of higher mortality rates with more advanced age (Figure 1). There were 302 male patients and 90 female patients. Sixty-seven percent of the patients were white, 12% were African American, 13% were Hispanic, and 5% were Asian. The average length of stay was 10 (±5) days, with the longest hospitalization being 114 days. The average cost of hospitalization was $21,830 (±$3,485). Figure 2 represents the geographic distribution of the patients in this series.

The average length of stay for 67 patients not requiring surgical intervention for any injury was 3 (±2) days, with no mortality. Two hundred forty-eight patients underwent one or more of the following: tracheotomy, endoscopy, and/or surgical repair of laryngeal injury. Seventy-seven patients went to the operating room for treatment of other injuries, with no record of procedures for ELT. There were 134 patients who underwent a tracheotomy, with an average length of stay of 15 (±3) days and a mortality rate of 5%. Patients not requiring a tracheotomy had an average length of stay of 7 (±2) days and a mortality rate of 0.78% (Figure 3). Thus, patients who required a tracheotomy had a higher mortality rate and a longer length of stay (P < .05); however, it was not possible to determine whether the tracheotomy was for ELT or other injuries (head injury, chest injury, etc.). In fact, of all patients who underwent a tracheotomy, only 58% had a primary diagnosis of ELT. Surgical repair of laryngeal injury was required in 96 patients, with an average length of stay of 13 (±2) days, and a mortality rate of 1%. Figure 4 demonstrates the distribution of medical and surgical management.

There were 180 patients who underwent endoscopy, consisting of direct laryngoscopy and/or bronchoscopy, with an average length of stay of 9 (±2) days and a mortality rate of 1%. Fourteen patients underwent endoscopy and tracheotomy without laryngeal repair. The average length of stay for these patients was 11 (±3) days, and the mortality rate was 2%. Fifty-seven patients un-
derwent endoscopy, tracheotomy, and surgical laryngeal repair, with an average length of stay of 13 (±3) days and a mortality rate of 1%. Sixty-eight patients underwent a tracheotomy without endoscopy or surgical laryngeal repair.

External laryngeal trauma was the primary diagnosis in 78% of patients who underwent endoscopy, tracheotomy, and/or laryngeal repair. Figure 5 illustrates other common primary diagnoses, excluding ELT. Surgical treatment was performed in 140 patients within 24 hours, while another 60 received treatment within 48 hours. Associated injuries included skull base or intracranial injury (13%), open neck injury (9%), cervical spine injury (8%), and esophageal or pharyngeal injury (3%) (Figure 6). The incidence of ELT was evenly distributed among the days of the week; however, the mortality rate was higher on Sundays (5%) and Saturdays (3%) than on the other days of the week (0%-2%).

**COMMENT**

Our study focused on 392 patients with ELT due to blunt injury. The type of information stored in the database limits the conclusions that can be drawn from this analysis; nonetheless, we believe that this study has identified important information with regard to the outcome of patients with ELT.

Previous studies have reported a higher incidence of ELT in smaller population samples. For all types of laryngeal injury, Gussack et al\(^2\) reported an incidence of less than 1% of trauma cases. Bent et al\(^4\) reported an incidence of 1/5000 emergency department visits in 1987 for both blunt and penetrating laryngeal injuries, while Schaefer\(^5\) reported an incidence of 1/30,000 emergency department visits over a 27-year period for blunt injuries alone. We suspect that the incidence varies with the sample size and geographic location; thus, we hoped to accurately determine the incidence of ELT by analyzing a large sample size selected from numerous geographic areas. Our reported incidence of 1/137,000 is less than that found by Schaefer (1/30,000 of emergency department visits), but our series reflects all inpatient records.

The average age in this series was 37 years. Previous studies involving both penetrating and blunt laryngeal trauma have reported lower mean ages, ranging from 26 to 34 years.\(^6,7\) The percentage of males and females affected is similar to that noted in previous reports. In this series, 77% of the patients were male and 33% were female. The percentage of males in previous reports has ranged from 75% to 90%.\(^6,7\)

With regard to outcomes, previous studies have estimated mortality rates to be as high as 15%.\(^8\) In this series, the overall mortality rate was 2.04%, with an apparent trend toward increasing mortality with increasing age. The average length of stay was 10 days, and the average medical cost was approximately $22,000; however, individual numbers vary considerably depending on the presence of any other injuries as well as on the severity of the laryngeal injury.

There were several interesting findings concerning the treatment of patients with ELT. Two hundred forty-eight (63%) of the 392 patients required surgical inter-
vention, including one or more of the following: endoscopy, tracheotomy, and/or surgical repair of laryngeal injury. One third of the patients required a tracheotomy. Tracheotomy was performed in fewer patients in our study than in other studies. Bent et al\(^1\) reported that 72% of the patients with penetrating or blunt injury required a tracheotomy. In the series of Gussack et al,\(^2\) 67% of the patients required a tracheotomy.

Half of the patients who underwent a tracheotomy did not undergo endoscopy at the time of surgery. We suspect that these figures may reflect deficiencies in coding and/or documentation or that the tracheotomy was performed for other reasons (eg, associated head or chest injury). Also, we were unable to assess whether specialists were involved with the care of these patients, and the fact that many of the patients underwent a tracheotomy without endoscopy may reflect differences in opinions about surgical management. Most authors support direct laryngoscopy and/or bronchoscopy if the laryngeal injury is such that a tracheotomy is required,\(^3\) and many support esophagoscopy at the time of laryngoscopy and bronchoscopy.\(^4\)

The patients who required a tracheotomy had a higher mortality rate and a longer length of stay than the patients who did not require a tracheotomy \((P<.05)\). It is impossible to control for all other factors when comparing these 2 groups; therefore, other injuries may have influenced the outcomes. Also, it is intuitive that more severe laryngeal injuries will require a tracheotomy and may be associated with more serious sequelae.

Direct laryngoscopy or bronchoscopy was performed in 45% of our patients. This figure is consistent with that in the study by Schaefer et al,\(^7\) in which endoscopy and surgical exploration were performed in 49% of the patients who presented with ELT. However, it is lower than in other studies involving both penetrating and blunt laryngeal injury, in which endoscopy was performed in 63% to 85% of patients.\(^2,4-7\) In our series, 8% of the patients undergoing endoscopy required only a tracheotomy, while 32% required a tracheotomy and open laryngeal repair.

External laryngeal trauma was the primary diagnosis in 78% of the patients who required surgical treatment of ELT. Most patients were treated soon after presentation, with 140 patients receiving surgical intervention within 24 hours and another 60 receiving treatment within 48 hours. The frequency of associated injuries is lower than that found in other studies; however, the incidence reported in previous studies may be falsely elevated because of smaller sample sizes. Associated injuries included skull base or intracranial injury (13%), open neck injury (9%), cervical spine injury (8%), and esophageal or pharyngeal injury (3%). Previously, esophageal injuries have been reported at 14%, closed head injuries at 28%, and spine trauma at 14%.\(^2,3\)

As previously mentioned, the format of this database is limited in the type of information that can be retrieved, and the results do not reflect outcomes of patients who were discharged from the emergency department. We also emphasize that each patient is different and requires individual treatment. Nonetheless, using a database drawn from more than 700 hospitals has several advantages. This study is not complicated by any selection bias based on referral pattern or surgeon’s interest. Also, this series represents a large sample size with a defined denominator. Finally, with appropriate interpretation and utilization, outcomes studies based on patient databases can favorably affect patient care. Physicians need to become more involved in improving these systems to ensure their ability to obtain, secure, and retrieve clinically relevant data in an efficient manner. In so doing, they will facilitate the accurate tracking of patient outcomes and spur the development of more effective ways to assess diagnostic and treatment patterns.

### CONCLUSIONS

The data obtained from this 11-state trauma database suggest that the incidence of and mortality associated with ELT is lower than previously reported. One third of the patients required a tracheotomy, and 50% of these procedures were performed without record of simultaneous endoscopy or laryngeal repair. Patients requiring tracheotomy had a higher mortality rate and a longer length of hospital stay. Direct laryngoscopy and bronchoscopy were performed in almost 50% of the patients. Most patients, 80%, received treatment within 48 hours after presentation. Even though associated injuries appear to be less common than previously indicated, our study findings confirm that cervical spine, pharyngeal, esophageal, and head injuries must be considered in the initial evaluation.

Accepted for publication February 19, 1999.

Presented in part at the annual meeting of the American Laryngological Association, Palm Beach, Fla, May 10, 1998.

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