Objective: To describe the results of an outcome survey of 18 cases of pediatric lymphangioma with dyspnea from encroachment on the tongue base, parapharyngeal space, and/or larynx.


Setting: Pediatric otolaryngology departments from 2 referral centers.

Patients: Eighteen patients were treated. The average age at initial surgery was 22 weeks (median, 5 weeks). All presented with at least unilateral suprahyoid and infrathyroid cavernous (microcystic) lymphangioma. The tongue base was involved in 11 patients, the parapharyngeal space in 12, and the larynx in 8.

Interventions: Neck dissection was performed initially in all patients. Tracheotomy was performed in 9 patients (50%). Macroglossia was treated by V glossoplasty. Parapharyngeal extensions were treated by cervicotomy or endoscopy, and larynx and tongue base extensions by carbon dioxide laser photocoagulation. Supraglottic laryngectomy was performed in 2 patients.

Main Outcome Measures: Residual disease, decannulation, duration of tracheotomy, and persistent respiratory symptoms.

Results: The average follow-up was 4 years postoperatively. One postoperative death occurred. Sixteen (94%) of the remaining 17 patients had residual lymphangioma. Eight (89%) of the 9 patients with tracheotomy underwent decannulation (average duration, 22 months). Ten patients had persistent symptoms, and 6 were asymptomatic.

Conclusions: Involvement of the upper airway seems to be the determining prognostic factor in extensive lymphangioma. Patients with dyspnea by external compression of cervical lymphangioma on the airway responded well to surgery. Aggressive surgical treatment did not seem to significantly improve the prognosis in patients with intrinsic involvement of the upper airway. The natural evolution of untreated massive lymphangioma has not been documented. Less aggressive, symptomatic therapy may be an alternative to avoid mutilating surgery in patients with intrinsic involvement of the airway.

Arch Otolaryngol Head Neck Surg. 2000;126:1378-1382

LYMPHANGIOMA is a rare congenital disease of unknown etiology. It has been called a malformation, a hamartoma, and an embryonic tumor.1-2 Cystic hygroma of the head and neck, with large lymphatic endothelium-lined cysts, is amenable to surgical excision. Cavernous or microcystic lymphangioma, however, is composed of small lymphatic spaces and poses a therapeutic dilemma by its propensity to cause airway and feeding difficulties and by its tendency to recur despite extensive surgery.

The mainstay of treatment for extensive lymphangioma is surgical excision, with the average number of interventions ranging from 1 to 4.1-3,5 Tracheotomy is necessary in more than 50% of patients.1,4-7 It would be logical to assume that the functional outcome would be even more severe in cases infiltrating the upper food and airway passages, in that complete excision without substantial morbidity is often impossible.

This study retrospectively reviews the outcomes in 18 patients with extensive lymphangioma and dyspnea by compression or intrinsic involvement of the airway.
PATIENTS AND METHODS

The pediatric otolaryngology departments from 2 tertiary care teaching hospitals participated in this study. Files from January 1983 to September 1998 were reviewed. Files of patients with pathologically proved cavernous lymphangioma and with dyspnea at initial presentation were retained for analysis. Histologically, cavernous lymphangioma was defined as a tumor made of multiple, millimeter-sized, endothelium-lined spaces, filled with eosinophilic debris and few erythrocytes. Cysts ranging from microscopic to several centimeters large were often associated. The Table summarizes the patients in the chronologic order of treatment.

Eighteen patients were treated (11 boys and 7 girls). Lymphangioma was apparent at birth in 11 (61%). For the remaining 7, initial presentation occurred at an average age of 24 weeks (range, 3-80 weeks).

All patients had at least unilateral suprathyroid and infrathyroid cavernous lymphangioma of the neck. Three had bilateral suprathyroid and unilateral infrahyoid lesions, and 7 had bilateral suprathyroid and infrahyoid lymphangioma. The anterior tongue was infiltrated in 7 patients (3 bilaterally and 2 unilaterally). The tongue base was involved in 11 patients, the parapharyngeal space in 12, and the supraglottic larynx in 8. Bilateral tongue base involvement was always associated with bilateral anterior lingual lymphangioma. In 2 patients (patients 4 and 5), spread to the aryepiglottic fold not noted initially was diagnosed 6 and 9 months, respectively, after initial surgery. Mediastinal extension occurred in 5 patients (4 unilaterally and 1 bilaterally).

Dyspnea ranged from heavy breathing and snoring to acute respiratory distress necessitating emergency tracheotomy. Mild respiratory symptoms were defined as those managed at home (2 patients). Moderate respiratory obstruction called for hospitalization (6 patients). Severe respiratory distress necessitated intubation and emergency surgery, tracheotomy, or both (10 patients). The average age at which dyspnea was diagnosed was 22 weeks (range, birth to 92 weeks). Nine patients (50%) had symptoms related to airway obstruction at or before the age of 4 weeks (3 moderate and 6 severe). Two polysomnographic analyses were performed, diagnosing 1 patient (patient 8) as having obstructive sleep apnea syndrome.

Files were reviewed to determine treatment modalities used. Patients were examined clinically and radiographically (by computed tomographic or magnetic resonance imaging scanning) for residual disease, respiratory symptoms (dyspnea, heavy breathing, or snoring), and feeding difficulties. All statistical tests were nonparametric, with a significance level (α) of .05.


Initial surgery consisted of 1-stage neck dissection, extended to the parotid, parapharyngeal space, submandibular triangle, and submental region as necessary. Tracheotomy alone was not considered “initial surgery” and was performed before, during, or after initial excision of the lymphangioma. Unilateral neck dissection was performed in 12 patients, bilateral in 4. One 1-stage neck and mediastinal dissection with sternotomy was also performed (patient 18). The median age at initial surgery was 5 weeks (average, 22 weeks; range, 1-88 weeks), reflecting the skewing of the distribution toward young ages.

Nine tracheotomies were performed (50%). The median age at tracheotomy was 12 weeks (average, 21 weeks; range, 2-92 weeks). Two additional patients remained intubated 2 weeks following surgery. Gastrostomy was performed in 4 patients, 2 of whom underwent tracheotomy as well. The average age at gastrostomy was 61 weeks (range, 12-106 weeks). Gastrostomy was only performed after long-term feeding via a nasogastric tube.

Each patient was operated on an average of 2.9 times (range, 1-5 times) (excluding interventions for tracheotomy, gastrostomy, or endoscopy). Neck and/or submandibular triangle dissection was performed an average of 2.1 times per patient (range, 1-4 times per patient). Thoracotomy was performed as a second stage after neck dissection in 3 patients. The average age at thoracotomy was 11 weeks (range, 6-16 weeks).

Six anterior partial glossectomies were performed in 5 patients, at ages ranging from 3 months to 11.8 years (median, 6 months). One basilgosseotomy by an external approach was performed after supraglottic laryngectomy, at 6.3 years (patient 2). Complete excision of the parapharyngeal lymphangioma by an external approach during neck dissection was attempted in all patients. Supraglottic laryngectomy and hemisupraglottic laryngectomy were performed in 1 patient each, at 61 and 18 months (patients 2 and 3, respectively).

Excluding endoscopy for diagnostic purposes, therapeutic endoscopy was performed in 7 (39%) of the 18 patients, with an average of 2.8 interventions per patient (range, 1-12 interventions per patient). Carbon dioxide laser photoacoagulation was performed in 6 patients, for supraglottic and/or base of tongue lesions. Sclerosing agent was endoscopically injected in the parapharyngeal space in 1 patient (patient 1).

Sclerosing agents were used in 4 other patients. In 1 patient, 2 injections were performed 1 year before surgery. In the 3 remaining patients, injections were performed for residual lesions after an average of 2.7 interventions in the region (the lateral neck in 2 patients and the parapharyngeal space in 1). A hemolytic streptococcal preparation (OK-432) was used in 1 patient for residual cervical and parotid lymphangioma.

Bilevel positive pressure ventilation by mask during sleeping hours was used to treat 1 patient (patient 8) with documented obstructive sleep apnea syndrome due to residual parapharyngeal lymphangioma. Low-molecular-weight heparin sodium and the application of leeches were used for 1 case of postoperative lingual engorgement and necrosis (patient 6).

One postoperative death occurred (age, 10 weeks) from cardiac arrest, following unilateral neck dissec-
There was no statistically apparent relation between age at onset of dyspnea and degree of dyspnea (Kruskal-Wallis test). The median duration of tracheotomy (from placement to decannulation or the cutoff date) was 12 months (average, 22 months; range, 1-114 months). Eight (89%) of the 9 patients with tracheotomy underwent decannulation. The average duration of gastrostomy was 18 months (range, 2-34 months). Gastrostomy was removed in 2 of 4 patients, and was still in use in 2. One additional patient (patient 6) was fed by a nasogastric tube for 2 years. Residual lymphangioma was apparent in 16 (94%) of 17 patients. In the remaining patient (patient 8), no residual lesions were clinically apparent 2 years after unilateral neck dissection and sternotomy. Of the 16 patients with residual lesions, 6 (38%) were asymptomatic. Three had asymptomatic cervical masses, located at the neck dissection limits. One had a residual upper mediastinal lesion with asymptomatic tracheal deviation on chest x-ray film. One had residual unilateral tonsillar fossa lymphangioma, and the last had residual unilateral parapharyngeal lymphangioma. These lesions were stable (no episodes of inflammation or increased volume), although the last patient was lost to follow-up at 1 month.

Of the 10 symptomatic patients (63%), 5 had symptoms related to persistent airway obstruction: tracheotomy (n=1); obstructive sleep apnea syndrome (n=1); and snoring, heavy breathing, and dyspnea on exertion (n=3). Five had symptoms related to feeding or to lymphangiomatous macroglossia: gastrostomy (n=2) and persistent macroglossia with chronic bleeding (n=3). There was no statistical relation between age at diagnosis of lymphangioma and persisting symptoms (Mann-Whitney test). Of the 9 patients who underwent tracheotomy, 3 were asymptomatic and had undergone decannulation at the end of the study. The average duration of tracheotomy in these patients was 10 months (range, 1-24 months). Six patients were still symptomatic at the end of the study, with an average duration of tracheotomy of 33 months (range, 1-114 months). The difference in duration of tracheostoma between the 2 groups was not statistically significant (P = .10; Mann-Whitney test).

At the end of the study, the 5 patients with macroglossia belonged to the symptomatic group. Four had undergone tracheotomy. Three underwent decannulation. One maintained a tracheotomy, one maintained a gastrostomy, and the other 3 had persistent macroglossia with chronic bleeding.

None of the 5 patients undergoing sclerotherapy showed signs of improvement. The residual lesions remained asymptomatic and stable in volume. For the patient treated preoperatively, the lesions continued to expand and surgery was ultimately required. The streptococcal preparation used in 1 patient (2 injections) had no apparent effect on residual cervical lymphangioma.

**Patient Descriptions and Outcomes**

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Tongue Base†</th>
<th>Parapharyngeal Space†</th>
<th>Larynx†</th>
<th>Lateral Neck†</th>
<th>Dyspnea Degree‡</th>
<th>Follow-up, mo</th>
<th>Outcome</th>
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<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>+++</td>
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<td>2</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>+++</td>
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<td>Decannulation after 114 mo</td>
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<tr>
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<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>++</td>
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<td>§</td>
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<td>++</td>
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<td>1</td>
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<td>11</td>
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<td>2</td>
<td>++</td>
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<td>0</td>
<td>1</td>
<td>++</td>
<td>24</td>
<td>No apparent residual lesion§</td>
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</table>

* OSAS indicates obstructive sleep apnea syndrome; Bi-PAP, bilevel positive pressure ventilation.
† ‡ indicates mild; +, moderate; and ++, severe (as defined in the “Patients and Methods” section of the text).
† † indicates no involvement; 1, unilateral involvement; and 2, bilateral involvement.
‡ § Asymptomatic.
obstruction.1,3,8,13 Nevertheless, the results of statistical analyses were not significant, owing to either the small absolute numbers or the heterogeneity of the cases.

The most important finding in this series was that intrinsic infiltration of the upper aerodigestive structures was a factor of poor prognosis. The prognostic effect of age at presentation, symptoms, and anatomic extent has previously been demonstrated.3,8,11 de Serres et al8 found a significant difference in outcome between unilateral infrahyoid and bilateral suprahylidend infrahyoid lymphangioma (stage I vs V). Ricciardelli and Richardson3 demonstrated that suprahylidend lymphangiomas had a significantly higher rate of recurrence than infrahyoid lymphangiomas. Raveh et al11 demonstrated that symptomatic lymphangioma and neonatal lymphangioma had significantly poorer outcome. These studies have shown the poor outcome of extensive lymphangioma compared with uncomplicated, limited, cystic hygroma of the neck. For these extensive lesions, the “suprahyoid” label has limits, in our opinion. Uncomplicated cystic lymphangioma of the submandibular region can be classified as suprahylidend, but generally does not have the poor prognosis of extensive cavernous lymphangioma.3,8 Cystic hygroma and cavernous lymphangioma may even be different cellular or physiologic entities, despite the widely accepted “unified concept” of Bill and Sumner.12 In addition, in our study, 3 patients had bilateral suprahylidend and unilateral infrahyoid lymphangioma, a stage falling in between stages IV and V in the classification by de Serres et al.8 In our series, stages ranged from III to V, but there was no obvious relation between outcome and stage. In our series, the degree of dyspnea did not affect outcome. However, our study is biased in that patients with “mild” airway obstruction were probably not transferred to our hospitals.

In this series, patients could be divided into 2 groups according to symptoms at outcome. One group was asymptomatic, while the other group still had symptoms related to upper airway obstruction. Asymptomatic outcome was seen in patients with airway compromise that seemed to be due to tracheal compression from cervical lymphangioma, with less lymphangiomatous infiltration of the upper airway. These types of lesions responded well to surgery. The average duration of tracheotomy was shorter than in the symptomatic group, although the difference was not statistically significant (10 vs 33 months). None of the asymptomatic patients had bilateral lymphangioma of the tongue base or supraglottic larynx. We believe that, for these patients, without extensive involvement of the upper aerodigestive structures, early surgery may reduce the duration of tracheotomy.

In the symptomatic group, the airway obstruction was attributable to intrinsic lymphangiomatous involvement of more than 1 level of the upper airway (tongue base, parapharyngeal space, and/or supraglottic larynx), often with bilateral lesions. All patients with macroglossia had symptoms related to the tongue lesions at the end of the study, although decannulation was possible in 3 patients. In our opinion, extensive infiltration of the upper aerodigestive structures is in itself an important predictive factor of poor prognosis.

The second finding in this series was that surgery of the upper aerodigestive structures was beneficial for some patients, but not all. Today, surgery is the mainstay of treatment.14,15 Some researchers advocate conservative surgery, with repeated partial resection. Others advocate extensive surgery, with maximal 1-stage tumor resection. For macroglossia, repeated partial glossectomy has the approval of many researchers.7,16 For the supraglottic larynx, many researchers take a conservative approach, using the carbon dioxide laser to superficially photocoagulate the larger cysts, leaving a long-term tracheostoma in place.3,8 Some researchers17,18 have successfully performed supraglottic laryngectomy in older children. It was our policy to perform surgery at an early age to remove cervical lymphangioma that may contribute to airway obstruction. We believed that if this was effective, we could avoid long-term tracheostoma. In the same way, aggressive glossectomy and laryngectomy were used, in an attempt to decannulate early and avoid the complications of long-term tracheostoma. The postoperative mortality of 6% (1/18) in the present series is compatible with the published data,1,3,7,13 in which mortality ranges from 0% to 38%. The rate of recurrence or residual lesions in reported series of extensive lymphangioma ranges from 38% to 80%.1,3,5,7,14 In our series, the rate of residual lymphangioma was 94%, which is compatible with the data published in the literature. From our observations, it does not appear that early aggressive surgery of the upper aerodigestive structures has a homogeneously positive impact on outcome.

It is essential, in our opinion, to weigh the permanent morbidity of surgery as opposed to the morbidity of a “watchful waiting” attitude and long-term tracheostoma.3 Studies19 have shown that the rate of late complications (accidental decannulation, tube obstruction, and granulation tissue) is directly related to the duration of tracheostoma. Zeitouni and Manoukian20 advocate their low number of major home care complications to “extensive teaching and careful follow-up.” Sometimes this is not feasible, however. For this reason, 2 partial laryngectomies and 6 glossectomies were performed, in an attempt to more rapidly obtain stabilization of the airway. Tracheotomy was even avoided in 1 case of unilateral lingual and laryngeal lymphangioma treated by partial laryngectomy, at the price of temporary aspiration of liquids and dysphonia.

For some patients, the direct role of surgery in decannulation was not chronologically obvious, especially in that tongue resection caused postoperative edema and aggravation of dyspnea.5,12 Low-molecular-weight heparin and leeches were used in 1 patient in our series. We hypothesize that this treatment could speed resolution of lingual engorgement after anterior glossectomy. Further studies will be necessary to determine if there is a real benefit to using heparin for the postoperative course in macroglossia. For these “massive” lymphangiomas,5 systematic neck dissection could theoretically aggravate airway obstruction by removing or blocking the cervical lymphatic and venous drainage routes. It may be useful to reconsider the order of treatment of the neck and the airway in patients with extensive infiltration of the upper
Extensive cavernous lymphangioma is an aggressive, albeit benign, disease with frequent local recurrence and symptomatic residual disease. Involvement of the upper aerodigestive tract seems to be a predictive factor of poor functional prognosis. In this series, aggressive surgery of the airway was performed for infiltration of the upper aerodigestive tract. In some cases, surgery improved the respiratory symptoms. In others, the benefits of surgery were not obvious or immediate. Early aggressive surgery of the upper aerodigestive tract, if possible, may lead to a better understanding of the natural history of lymphatic malformations.

Histological markers allowing evaluation of surgical margins or tumor proliferation are also still lacking.

CONCLUSIONS

Extensive cavernous lymphangioma is an aggressive, albeit benign, disease with frequent local recurrence and symptomatic residual disease. Involvement of the upper aerodigestive tract seems to be a predictive factor of poor functional prognosis. In this series, aggressive surgery of the airway was performed for infiltration of the upper aerodigestive tract. In some cases, surgery improved the respiratory symptoms. In others, the benefits of surgery were not obvious or immediate. Early aggressive surgery of the upper aerodigestive tract, if possible, may lead to a better understanding of the natural history of lymphatic malformations.

Histological markers allowing evaluation of surgical margins or tumor proliferation are also still lacking.