



Objective endoscopic findings in patients with recurrent croup: 10-year retrospective analysis[☆]



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ARTICLE INFO

Article history:

Received 28 June 2015

Received in revised form 21 October 2015

Accepted 22 October 2015

Available online 30 October 2015

Keywords:

Recurrent croup
Subglottic stenosis
GERD
LPR
Bronchoscopy
Esophagoscopy

ABSTRACT

Objective: (1) To determine the incidence and severity of subglottic stenosis on endoscopic evaluation in a pediatric population of patients with recurrent croup. (2) To determine the incidence of abnormal findings on bronchoalveolar lavage and esophageal biopsy in a pediatric population with recurrent croup.

Methods: Case series with historical chart review of clinical data for pediatric patients (age ≤ 18 years) at a tertiary care children's hospital who underwent endoscopic evaluation of the upper aerodigestive tract with a diagnosis of recurrent croup over a ten-year period (2002–2012). Subglottic stenosis was graded on Myer–Cotton scale. Lipid-laden macrophages on bronchoalveolar lavage were noted as none/small/moderate/large with evidence of reflux noted as moderate or large. Esophageal biopsy specimens were evaluated for evidence of esophagitis. Data is expressed as mean \pm SEM.

Results: 1825 charts were reviewed of which 197 met inclusion criteria. Mean age at endoscopy was 53 ± 3 months. Subglottic stenosis was noted in 41 patients (20.8%) with 95.1% being mild or Grade I. Abnormal findings on bronchoalveolar lavage were noted on 9.5% of bronchoalveolar lavage specimens. Abnormal esophageal biopsies were noted on 19.9% of specimens. Esophagitis was noted on 8.8% of biopsy specimens.

Conclusions: Subglottic stenosis is a risk factor for recurrent croup. Evidence suggestive of reflux may be noted on bronchoalveolar lavage or esophageal biopsy, but these findings may not correlate with subglottic stenosis in recurrent croup patients.

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[☆] Podium Presentation at American Academy of Otolaryngology—Head and Neck Surgery Foundation 2014 Annual Meeting, September 21–24, 2014, Orlando, Florida.

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1. Introduction

Croup is a common respiratory condition in the pediatric population manifesting with symptoms including barking cough, stridor, hoarseness, and/or respiratory distress. Up to 15% of children have been affected at least once in their lifetime [1]. Recurrent croup has an incidence of approximately 5% in large population studies [2]. Previous studies have noted increased incidence of subglottic stenosis (SGS) in patients with recurrent croup [3,4]. Gastroesophageal reflux disease (GERD) has also been associated with recurrent croup [5–7].

At our institution, patients with recurrent croup recalcitrant to medical therapies commonly undergo operative upper

aerodigestive tract endoscopy involving direct laryngoscopy, rigid bronchoscopy with bronchoalveolar lavage (BAL), and rigid esophagoscopy with biopsy. Cytological evaluation of bronchoalveolar lavage specimens for lipid-laden macrophages (LLM) is associated with aspiration and may occur with GERD and laryngopharyngeal reflux (LPR) [8]. Esophageal biopsies allow for direct examination of histopathological evidence of reflux esophagitis as well as eosinophilic esophagitis, which may also be associated with airway inflammation [9].

Previous studies of endoscopic findings in recurrent croup have been limited by small sample sizes, with the largest study having 90 patients [10]. Cytological and pathological evidence of reflux in recurrent croup is even more limited. Thus, the objective of this study is to determine the incidence of SGS on operative endoscopy in patients with recurrent croup and to test the hypotheses that recurrent croup is associated with endoscopic and objective findings of LPR/GERD in patients with endoscopic findings of SGS.

2. Methods

Institutional Review Board approval was obtained. Chart review was performed for all pediatric patients (age ≤ 18 years) over a ten-year period who underwent operative endoscopy between 2002 and 2012. The operative database was queried for all patients with a diagnosis of croup, cough, or GERD during this time frame. Inclusion criteria included at least two lifetime episodes of croup. Patients with a prior endoscopy for another etiology were included if the current endoscopy was the first for a diagnosis of recurrent croup. Patients undergoing other associated procedures at the time of airway evaluation, e.g., tympanostomy tube placement, were not excluded from analysis. Patients who underwent an endoscopic airway evaluation for recurrent croup prior to the timeframe of the study or had a preexisting diagnosis of SGS were excluded.

Direct laryngoscopy, rigid bronchoscopy, and rigid esophagoscopy were performed by the otolaryngology team with or without bronchoalveolar lavage or esophageal biopsy. Airway sizing was performed using an uncuffed endotracheal tube after the bronchoscopy and prior to the esophagoscopy. Anesthesia was induced with sevoflurane followed by intravenous access placement. Anesthesia was maintained by propofol infusion with spontaneous ventilation. No paralytics were utilized. Flexible bronchoscopy or flexible esophagogastroduodenoscopy were performed by the pulmonary service or gastroenterology service, respectively, on select patients. However, all airway findings were obtained from review of the otolaryngic rigid bronchoscopy notes. Further details regarding the technical details of the equipment and airway endoscopy at our institution are noted as per Mandell et al. [11].

Demographic data collected included age at endoscopic evaluation, gender, and duration of hospitalization. Operative reports were reviewed for severity of SGS according to Myer–Cotton grading scale [12]. Bronchoalveolar lavage results were reviewed for the presence of LLM and categorized as none, small, moderate, or large. Moderate and large numbers of LLM were considered significant for evidence of reflux [8]. Esophageal biopsy pathological reports were reviewed. Results were categorized as normal epithelium, suggestive of reflux esophagitis, suggestive of eosinophilic esophagitis, suggestive of reflux esophagitis with eosinophilic esophagitis, and evidence of esophageal candidiasis. Data is expressed as mean \pm SEM. Statistical analysis was performed using Mann–Whitney Rank Sum test, Fisher Exact test, and χ^2 -analysis where appropriate. Statistical significance was defined as $p < 0.05$.

3. Results

The initial database query noted 1825 patients who underwent operative aerodigestive tract evaluation for a diagnosis of croup, cough, or GERD during the time period between 2002 and 2012. Of these patients, 197 patients met criteria for recurrent croup and underwent initial airway evaluation for this diagnosis. The population included 141 males and 56 females, a nearly 2.5:1 ratio. There was no difference in male and female demographics for age at endoscopy or duration of hospitalization. A total of 41 patients were identified with SGS, representing 20.8% of the total population.

Table 1 lists demographic data for the group with SGS on operative endoscopy and the group without evidence of SGS on operative endoscopy. Fisher Exact test analysis noted that gender was not a factor in presence or absence of SGS ($p = 0.307$). Age at endoscopy was significantly younger in the SGS group compared with the group without SGS (35 months vs. 58 months, respectively, $p < 0.001$). Subglottic stenosis was noted in 41 patients (20.8%) in this population. Of the 41 patients with SGS, 39 or 95.1% were found to be grade I (0–50% obstruction). One instance of grade II obstruction and one instance of grade III obstruction were noted (2.4% each). No instances of grade IV obstruction were identified in this population.

Table 2 lists BAL results. Evidence suggestive of reflux defined as moderate numbers of LLM or large numbers of LLM was noted in 15 of the 158 total BAL specimens (9.5%). Evidence suggestive of reflux was noted in 0 of the BAL specimens in the SGS group and in 15 (11.4%) of the specimens in the group without SGS. χ^2 -analysis of the two groups noted no difference in the distribution of BAL specimens between the group with SGS and the group without SGS ($p = 0.265$).

Table 3 lists esophageal biopsy results. Abnormal esophageal biopsies were noted in 36 of the 181 total specimens (19.9%). Biopsies suggestive of reflux esophagitis were noted in a total of

Table 1

Demographic data of patients with subglottic stenosis and patients without evidence of subglottic stenosis noted on operative endoscopy in pediatric population with history of recurrent croup. Data expressed as mean \pm SEM.

Category	Total	Subglottic stenosis (SGS)	No subglottic stenosis (NSGS)	<i>p</i>
Number	197	41	156	
Age at endoscopy (months)	53 \pm 3	35 \pm 6	58 \pm 3	<0.001
Duration of hospitalization (days)	0.9 \pm 0.2	2.6 \pm 0.9	0.5 \pm 0.1	0.112
Gender				0.307
Male	141	28	113	
Female	56	13	43	

Table 2

Results of cytological analysis of bronchoalveolar lavage specimens. Data expressed as mean \pm SEM. Percentage of total in parentheses.

Category	Total	Subglottic stenosis (SGS)	No subglottic stenosis (NSGS)	<i>p</i>
Number	197	41	156	
Bronchoalveolar lavage	158	26	132	0.265
Insufficient for analysis		0	3 (2.3%)	
Normal (none-small)	143 (90.5%)	26 (100%)	114 (86.4%)	
Abnormal (moderate-large)	15 (9.5%)	0 (0.0%)	15 (11.4%)	
Moderate	13 (8.2%)	0 (0.0%)	13 (8.2%)	
Large	2 (1.3%)	0 (0.0%)	2 (1.3%)	

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