The Role of *Chlamydia pneumoniae* Infection in Children With Chronic Sinusitis

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**Background:** *Chlamydia pneumoniae* infection is a frequent cause of lower respiratory disease in both adults and children. However, its role in upper respiratory disease, including sinusitis, is less clear.

**Objective:** To determine the role of infection with *C pneumoniae* in chronic sinusitis in children.

**Design:** Prospective collection of specimens.

**Setting:** Tertiary care academic medical center.

**Participants:** Children with clinical and radiologic evidence of chronic sinusitis unresponsive to medical management undergoing adenoidectomy, maxillary sinus lavage, or endoscopic sinus surgery for treatment.

**Intervention:** Nasopharyngeal and middle meatal swabs and portions of surgical specimens were obtained and cultured for *C pneumoniae*.

**Results:** Specimens were obtained from 20 children (14 boys and 6 girls) aged 3 through 16 years. Thirteen bilateral endoscopic ethmoidectomies with maxillary antrostomies, 10 adenoidectomies, and 3 bilateral maxillary sinus lavages were performed. *Chlamydia pneumoniae* was isolated from the nasopharyngeal swab and adenoid tissue of 1 child (aged 6 years); however, his middle meatal swabs and maxillary sinus aspirates were negative. After 10 days of treatment with clarithromycin, repeat nasopharyngeal cultures were negative for *C pneumoniae*.

**Conclusions:** With the use of sensitive culture methods, *C pneumoniae* was not isolated from sinus specimens of children enrolled in this study. This preliminary study suggests that *C pneumoniae* does not play a significant role in chronic sinusitis in children.


It is estimated that between 5% and 10% of upper respiratory tract infections in children progress to acute sinusitis, with even fewer cases progressing to chronic sinusitis. Chronic sinusitis is defined as persistent symptoms of nasal congestion, rhinorrhea, cough, or facial pain or headache lasting more than 3 months, or 6 episodes per year of recurrent acute sinusitis each lasting at least 10 days with persistent changes on computed tomography 4 weeks after medical therapy without an intervening acute infection. Children who do not respond to appropriate medical therapy, usually consisting of 3 to 6 weeks of broad-spectrum antibiotics and possibly intranasal corticosteroids, nasal saline irrigations, decongestants, and allergy management, are often referred for surgery. First-line surgical management usually consists of an adenoidectomy to remove the adenoid pad as a source of bacterial contamination to the sinuses. Procedures including middle meatal culture and maxillary sinus aspirations and irrigations may also be performed as a first-line surgical therapy depending on the affected sinuses and preferences of the surgeon. Children who do not respond to first-line surgical treatment may require endoscopic ethmoidectomies with middle meatal antrostomies to provide adequate drainage pathways for the ethmoid and maxillary sinuses.

The predominant organisms responsible for chronic sinusitis are *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis*, *Staphylococcus aureus*, α-hemolytic streptococcus, and occasionally anaerobes. *Chlamydia pneumoniae*, an obligate intracellular bacterial parasite, is emerging as a frequent cause of lower and upper respiratory disease in both children and adults. Although it has been isolated from 1 adult patient with acute sinusitis, its role in pediatric acute and chronic sinusitis is unknown. Our spe-
Specific aim was to collect specimens from pediatric patients undergoing surgical treatment for refractory chronic sinusitis and, by using sensitive culture techniques, to determine the role of *C. pneumoniae* in pediatric chronic sinusitis.

### METHODS

Children aged 2 through 18 years who were scheduled for surgical intervention for treatment of chronic sinusitis were recruited from the private practice of 3 pediatric otolaryngologists and the otolaryngology clinics of the Long Island College Hospital and the University Hospital of Brooklyn, Brooklyn, NY, from June 1, 2000, to August 31, 2001. All children enrolled were scheduled independent of the study for one or more of the following surgical procedures: adenoidectomy, unilateral or bilateral maxillary sinus lavage, and unilateral or bilateral endoscopic ethmoidectomy with middle meatal antrostomy. The routine practice of our department is to recommend surgery for children with symptoms of chronic sinusitis for at least 3 months despite appropriate medical therapy. All children had a sinus radiograph or paranasal sinus computed tomographic scan demonstrating mucosal thickening of at least 4 mm, opacification, or an air-fluid level in at least 1 maxillary or ethmoid sinus. Patients with known immunodeficiencies, cystic fibrosis, congenital syndromes, intracranial and/or intraorbital sinus complications, and those who received macrolide antibiotic treatment within 2 weeks of surgery were excluded from the study.

Surgical procedures were performed with the patient under general anesthesia. All patients underwent unilateral or bilateral endoscopically guided middle meatal swabs, depending on the extent of disease. A nasopharyngeal swab was also performed either under visualization with the nasal endoscope or under direct visualization before adenoidectomy. Vogan et al demonstrated a 90% correlation between bacterial pathogens isolated by endoscopically guided middle meatal swabs and maxillary sinus aspirations. Previous studies have also demonstrated a high correlation between adenoid and sinonasal bacterial pathogens. Cultures for *C. pneumoniae* were collected with wire-shafted Dacron swabs (Dacroswab; Spectrum Laboratories, Los Angeles, Calif). Specimens obtained from adenoidectomy, maxillary sinus lavage, and endoscopic ethmoidectomy were also sent for *C. pneumoniae* culture. Aerobic and anaerobic cultures were obtained from all maxillary sinus lavages and from selected other sites at the discretion of the attending surgeon.

Cultures for aerobes and anaerobes were performed by standard techniques. Swabs for *C. pneumoniae* culture were immersed in 2 mL of transport medium containing a sucrose phosphate buffer with 20% fetal calf serum, 10 µg of gentamicin sulfate per milliliter, 10 µg of vancomycin hydrochloride per milliliter, and 1 µg of amphotericin B per milliliter. The specimens were refrigerated for up to 24 hours or frozen at −70°C if not cultured within that period. Cultures for *C. pneumoniae* were performed in cycloheximide-treated HEp-2 cells grown in 96-well microtiter plates. All specimens were passed once, and culture confirmation was accomplished by fluorescent antibody staining with a species-specific monoclonal antibody (Washington Research Foundation, Seattle). The cell culture method has been demonstrated to be highly sensitive for detecting *C. pneumoniae* in respiratory specimens.

Patients who had any specimen positive for *C. pneumoniae* were offered antimicrobial treatment with clarithromycin, erythromycin, or azithromycin. A follow-up culture for *C. pneumoniae* from the nasopharynx or middle meatus was performed, with the use of the above culture techniques, at 4 weeks after therapy in the office, only if one of these sites was initially culture positive for *C. pneumoniae*. Further therapy was dictated by the patient’s clinical course and follow-up culture findings.

### RESULTS

Twelve children, aged 3 through 16 years, whose demographics are presented in Table 1, entered and completed the study. Thirteen bilateral endoscopic ethmoidectomies with maxillary antrostomies, 10 adenoidectomies, and 3 bilateral maxillary sinus lavages were performed. Seven children underwent simultaneous bilateral myringotomy and tube insertion for treatment of otitis media with effusion, and 2 children underwent tonsillectomy for treatment of recurrent tonsillitis. A total of 97 *C. pneumoniae* cultures were obtained; however, cultures were inadvertently not obtained from the nasopharyngeal and middle meatal swabs of one child and the middle meatal swabs from another child (Table 2).

*Chlamydia pneumoniae* was isolated from the nasopharyngeal swab and adenoid tissue of 1 child (aged 6 years); however, his middle meatal swabs and maxillary sinus aspirates were negative for *C. pneumoniae*. *Hae-mophilus influenzae* and *S. aureus* were isolated from aerobic cultures of his maxillary lavage. He was initially treated postoperatively with a combination of amoxicillin and clavulanic acid. After the *C. pneumoniae* culture results were obtained, he was treated with 10 days of clarithromycin. After treatment, repeat nasopharyngeal cultures were negative for *C. pneumoniae*. This child clinically improved after his surgery in June 2000, but he was treated with antibiotics for 3 episodes of acute sinusitis during the winter after his surgery and still required daily intranasal corticosteroids and saline irrigations with nasal wash (Rinoflow; Mefar, Bovezzo, Italy, distributed by Respironics, Inc, Murrysville, Pa) during the winter.

*Chlamydia pneumoniae* was not found in any of the sinus specimens obtained from the 20 children in this study. On the basis of our small sample size, the preva-

### Table 1. Patient Demographics and Surgical Procedures

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Finding</th>
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<tr>
<td>Age, y</td>
<td>8.3 ± 3.6</td>
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<td>Range</td>
<td>3-16</td>
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<tr>
<td>Sex, No. (%)</td>
<td>Male 14 (70) Female 6 (30)</td>
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<td>Race, No. (%)</td>
<td>White 16 (80) African American 2 (10) Hispanic 2 (10)</td>
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<td>Surgical procedures, No.</td>
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<tr>
<td>Bilateral endoscopic ethmoidectomies with maxillary antrostomies</td>
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<tr>
<td>Bilateral endoscopic ethmoidectomies with maxillary antrostomies with adenoidectomy</td>
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<tr>
<td>Adenoidectomy</td>
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<td>Adenoidectomy with bilateral maxillary lavage</td>
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This study was approved by the institutional review boards at the State University of New York Downstate Medical Center, Brooklyn, and the Long Island College Hospital. For each patient, a written informed consent was obtained from parent or legal guardian before participation in the study.
Infections are thought to be mild or asymptomatic. In and reaching 30% to 45% by adolescence; however, most body to rologic surveys have documented the prevalence of anti-
dia; however, only 2 of these children were infected with
C pneumoniae alone. Ogawa et al cultured C pneumoniae
from the middle ear aspirates of 14% of patients with otitis
media with effusion. However, Goo et al, using poly-
merase chain reaction, did not identify C pneumoniae DNA
in any of the middle ear fluids from the 75 patients with
otitis media with effusion. Although Grayston et al
demonstrated evidence of sinusitis in 12% of their patients
with bronchitis and 7% of those with pneumonia caused by
C pneumoniae, C pneumoniae has been identified from the
maxillary sinus of only 1 adult with acute sinusitis in Ja-
pan. Thus far, there have been no attempts to identify
C pneumoniae in pediatric patients with chronic sinusitis.

Our study examined 36 surgical specimens and 61
culture swabs for the presence of C pneumoniae in 20 chil-
dren with chronic sinusitis. Cell culture for detection of
C pneumoniae is considered to be the gold standard for
detection of C pneumoniae infection; therefore, this tech-
nique was used for C pneumoniae diagnosis for this study.
Chlamydia pneumoniae was isolated from the nasophary-
xyn and adenoid tissue of only 1 boy who underwent an
adenoidectomy and bilateral maxillary sinus lavage. Cul-
tures of his middle meatal swabs and maxillary sinus as-
pirates were negative for C pneumoniae. Aerobic cul-
tures from his sinus lavage tested positive for H influenzae
and S aureus, which are known to play a significant role
in pediatric sinusitis.

Because of the absence of C pneumoniae and the pres-
ence of the more conventional pathogens cultured from
the maxillary sinus lavages, the C pneumoniae present in
the nasopharynx and adenoid was unlikely the primary
pathogen responsible for this child's chronic sinusitis.
Studies have shown that C pneumoniae is able to estab-
lish asymptomatic or subclinical infection in patients, as
it has been isolated from the nasopharynx of 5% of healthy
children and adults. Chlamydia pneumoniae may have

Table 2. Total Specimens Collected for Culture*

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<tr>
<th>Patient No.</th>
<th>Nasopharynx Swab</th>
<th>Right Middle Nasopharynx Swab</th>
<th>Left Middle Nasopharynx Swab</th>
<th>Adenoid</th>
<th>Right Maxillary Lavage</th>
<th>Left Maxillary Lavage</th>
<th>Right Sinus Specimen</th>
<th>Left Sinus Specimen</th>
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<td>Total No.</td>
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*X indicates specimen collected; +, positive culture for Chlamydia pneumoniae.
been a cofactor in the development of sinusitis in this child. The organism may have caused local inflammation, enabling other pathogens to invade. Coinfections with other organisms, including *Mycoplasma pneumoniae* and *Streptococcus pneumoniae*, have been reported in children with pneumonia caused by *C pneumoniae*. There are no data on the role of other atypical respiratory pathogens such as *M pneumoniae* in chronic sinusitis, and identification of that organism requires specialized methods that are not widely available.

This is the first report, to our knowledge, of the isolation of *C pneumoniae* from the adenoid core. Previous studies of upper and lower respiratory tract disease have predominantly used nasopharyngeal or throat swabs. The failure to isolate *C pneumoniae* from any of the other children, however, suggests that the organism is not a significant pathogen in pediatric chronic sinusitis.

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