In Brief

Sinusitis

Allison Taylor, MD
Children's Hospital at Montefiore
Bronx, NY

Author Disclosure
Drs Taylor and Adam did not disclose any financial relationships relevant to this In Brief.

Pediatric Sinusitis. Zacharisen M, Casper R. *Immunol Allergy Clin North Am.* 2005;25:313–332

Treatment of Pediatric Sinusitis. Goldsmith AJ, Rosenfeld RM. *Pediatr Clin North Am.* 2003;50:413–426

Management of Sinusitis. Clinical Practice Guideline: American Academy of Pediatrics Subcommittee on Management of Sinusitis and Committee on Quality Improvement. *Pediatrics.* 2001;108:798–808

Sinusitis is one of the more poorly understood and inadequately studied entities in pediatrics. In the absence of any reliable tests or physical examination findings, the diagnosis often depends on the history alone as the means of distinguishing it from the common cold. For a seemingly benign entity that often resolves spontaneously, sinusitis is associated with symptoms that can affect a patient's quality of life and complications that can be life-threatening.

Sinusitis is defined as inflammation of the normally sterile paranasal sinuses due to bacterial infection. Rhinosinusitis (RS) is the term currently used because the inflammation is believed to begin in the nasal epithelium (rhinitis). The exact incidence of sinusitis is unknown. However, it is estimated that of the average six to eight upper respiratory tract infections (URIs) per year experienced by school-age children, 5% to 10% will be complicated by RS. It also is estimated that 6% to 13% of children will have had one case of RS by the age of 3 years. RS also is classified by the duration of days of persistent symptoms. Acute rhinosinusitis (ARS) refers to symptoms that last longer than 10 days but fewer than 30. Subacute infection lasts between 30 and 90 days, recurrent infection lasts for fewer than 30 days but recurs after an asymptomatic period of 10 or more days, and chronic infection is defined as symptoms lasting longer than 90 days.

There are four pairs of air-filled sinus cavities. The maxillary and ethmoid sinuses are fully formed and clinically significant from birth. The sphenoid sinuses begin to develop at age 3 years and are fully formed by age 7 to 8 years. The frontal sinuses are the last to develop and are not fully formed until the early teenage years. All of the sinus cavities drain via narrow channels called ostia, which empty into a nasal meatus. The osteomeatal complex is the confluence of ostia draining the frontal, maxillary, and anterior sphenoid sinuses that empties into the middle meatus. Obstruction of the osteomeatal complex sets the stage for the development of RS.

The diagnosis of ARS depends primarily on history; most often there are no specific physical findings beyond those typical of a URI. ARS is defined as unabated upper respiratory tract symptoms lasting longer than 10 days or as worsening of symptoms by 7 to 10 days of illness. It is important to distinguish a single prolonged illness from consecutive URIs, which may seem to the parent to be one continuous episode, but which typically have a period of relative improvement before the recrudescence of symptoms. The symptoms of ARS include nasal discharge, cough (typically day and night), and halitosis. An alternative and less common presentation of ARS is the concurrent onset of high fever along with severe URI symptoms lasting 3 to 4 days. When fever precedes the URI symptoms, the illness is more likely to be viral. Older children and adolescents may present with symptoms more typical of adult disease: headaches, facial pain and pressure, maxillary dental pain, pharyngitis, and frequent throat clearing.

More often than not, no physical examination findings are present to help in making the diagnosis. If, however, purulent nasal discharge is seen draining from the middle meatus, a diagnosis of ARS can be fairly certain. This finding may be recognized by looking through the otoscope while gently pushing up on the nares, a technique not easily done, especially with younger children. Ethmoid sinusitis may be accompanied by periorbital edema. In older children and adolescents, gentle pressure on the maxillary and frontal sinuses may elicit pain or discomfort.

Viral URI undoubtedly is the most common causative factor in ARS, but other underlying conditions must be considered if recurrence is to be minimized. Allergic rhinitis is a significant contributor to the incidence of RS in children, particularly chronic RS (CRS). Adenoidal tissue can contribute to the problem, either by causing obstruction or by acting as a reservoir for bacterial pathogens. Structural anomalies such as deviated nasal septum, nasal polyps (which can be associated with cystic fibrosis), and foreign body (important to

consider in preschool-age children who demonstrate unilateral purulent nasal discharge) can obstruct the ostiomeatal complex. Immunodeficiency, primary ciliary dyskinesia, and cystic fibrosis may predispose to frequent respiratory infections as well as to RS. Gastroesophageal reflux disease (GERD) also has been described as a contributing factor, especially to CRS, because reflux has been shown to extend into the nasopharyngeal area.

Radiography usually is not helpful in diagnosing RS because of its relatively low specificity. In fact, imaging is not recommended for the diagnosis and management of uncomplicated sinusitis. Computed tomography (CT) scans of the sinuses can be useful, however, in the evaluation of patients who have recurrent sinusitis or RS with complications and in patients who have CRS and are being considered for surgery. Scans may be helpful in identifying polyps, foreign bodies, or anatomic irregularities that could be contributing to the ongoing clinical problem. Mucosal thickening, air-fluid levels, and sinus opacification are considered positive findings suggestive of RS on CT scanning. Although more expensive than plain films, CT scans provide superior visualization of the sinus cavities as well as of the orbits and intraorbital spaces. Magnetic resonance imaging is the study of choice if intracranial complications are suspected.

The gold standard for the diagnosis of RS is direct sinus aspiration, an invasive and painful procedure not routinely recommended for general pediatricians. The procedure is usually reserved for complicated cases or when treatment requires the isolation of a specific organism for identification of antibiotic sensitivities. Unfortunately, cultures of nasal secretions do not correlate with sinus aspirates and are not considered helpful.

The microbiology, bacterial resistance patterns, and antibiotics of choice are the same for RS as for otitis media. *Streptococcus pneumoniae*, nontypeable *Haemophilus influenzae*, and *Moraxella catarrhalis* are the predominant bacterial pathogens. In addition, anaerobic organisms and *Staphylococcus aureus* tend to be implicated in CRS. Nationwide, about 25% of pneumococci are resistant to penicillin by virtue of an alteration in the penicillin-binding site protein; 50% of *H influenzae* and 100% of *M catarrhalis* organisms are resistant to penicillin through the production of beta-lactamase. Factors associated with an increased risk for bacterial resistance include age younger than 2 years, attendance in child care, and use of antibiotics within the last 3 months.

Amoxicillin is the drug of choice for the treatment of ARS. A dose schedule of 45 mg/kg per day or 90 mg/kg per day is appropriate, depending on the presence of specific risk factors. The lower dose can be used for children who are older than 2 years of age, who are not in child care and have not received antimicrobial therapy recently, and whose sinusitis is not severe. Clinicians, however, may opt to use the higher dosage even in those patients. Patients allergic to penicillin can be treated with an oral second- or third-generation cephalosporin (cefuroxime, cefdinir, cefpodoxime) unless the severity of the allergy raises concern about the consequences of potential cross-reactivity. In that situation, a macrolide such as clarithromycin or azithromycin is indicated. Clindamycin is an alternative for penicillin-allergic patients known to be harboring penicillin-resistant pneumococci. Other antibiotics used in the past (trimethoprim-sulfamethoxazole and erythromycin-sulfisoxazole) no longer are recommended because of increased pneumococcal resistance.

If improvement is not apparent after 3 days of amoxicillin therapy or if the patient presents initially with high fever and more severe upper respiratory tract symptoms than usual, high-dose amoxicillin/clavulanate (90 mg/kg per day of amoxicillin) is the drug of choice, with a second- or third-generation cephalosporin as an alternative. A single parenteral dose of ceftriaxone followed 24 hours later by a course of oral antibiotic can be used if vomiting is an issue at the time of diagnosis. In the absence of improvement after 3 days of such second-line treatment or if the child is severely ill at presentation, consultation with an otolaryngologist or administration of an intravenous antibiotic such as cefotaxime or ceftriaxone is indicated.

Evidence is not available to establish the optimal duration of therapy. Various treatment lengths have been recommended, including 10-, 14-, and 28-day courses. Alternatively, the suggestion to treat for 7 days after resolution of symptoms ensures a minimum of 10 days of treatment and avoids excessive use of antibiotics, which could contribute further to the problem of bacterial resistance.

No adjuvant therapy for the treatment of ARS has been validated through clinical studies. Nonetheless, many physicians continue to prescribe treatments that may provide symptomatic relief. The nonsedating antihistamines may be helpful for children whose ARS is a consequence of underlying allergy. Normal saline nasal sprays are inexpensive and benign and may help to clear secretions. Topical nasal sympthomimetics used for more than 3 days can cause a rebound effect with increased congestion.

Surgery generally is reserved for patients who have recurrent or refractory RS that has not responded to maximal medical therapy, who are unlikely to have untreated allergy or GERD, and who are not suffering from a systemic illness that predisposes them to ongoing sinus infections. If these conditions are met, adenoidectomy generally is the procedure of choice because it is as-

sumed that the adenoids are serving as a reservoir for bacterial pathogens. The procedure is safe, with minimal morbidity and a 70% to 80% rate of improvement. Endoscopic surgery, used less commonly, is an alternative intervention designed to enlarge the ostia of the maxillary and ethmoid sinuses.

Complications from RS are rare. When they do occur, however, they can be serious and even life-threatening. Ophthalmologic complications are the most frequently encountered and include preseptal and orbital cellulitis, optic neuritis, and subperiostial abscess of the orbit. Presenting findings can include swelling of the eyelid, proptosis, impaired visual acuity, and decreased extraocular movements. Central nervous system involvement may be manifested by evidence of increased intracranial pressure: vomiting, headache, nuchal rigidity, altered mental status, and hemiparesis or other focal neurologic signs. Immediate CT scanning is warranted to identify possible cavernous sinus thrombosis, meningitis, subdural empyema, brain abscess, or osteomyelitis of the frontal bone (Pott puffy tumor). Depending on the nature of the complication, emergency surgical drainage may be indicated.

For the primary care practitioner, a thorough history remains the most important tool in diagnosing ARS. Other diagnostic considerations include not only the common cold and allergic rhinitis, but toothache, chronic cough caused by other infectious causes, and poorly controlled asthma. With stricter attention to the criteria for diagnosing sinusitis and with adherence to recommendations for treatment, beginning with narrower- rather than broader-spectrum agents, we can hope to limit the inappropriate use of antibiotics and not contribute further to the dangerous escalation of bacterial resistance.

Comment: In the face of reported allergy to penicillin, many pediatricians are hesitant to prescribe cephalosporins, fearful of cross-reactivity. Only about 10% of patients who are reported to be allergic to penicillins truly are, and evidence is accumulating that cephalosporins that have side chains dissimilar to benzylpenicillin are less likely to cross-react. The American Academy of Pediatrics practice guidelines for the treatment of sinusitis and otitis media support the use of second- and third-generation cephalosporins that have side chains that are structurally unrelated to the side chains of penicillins, in particular, cefuroxime, cefdinir, and cefpodoxime. The obvious exception noted in the guidelines is the child who has had a severe reaction to a penicillin, either anaphylaxis, toxic epidermal necrolysis, or Stevens-Johnson syndrome.

Henry M. Adam, MD
Editor, In Brief