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Acute Sinusitis—Principles of Judicious Use of Antimicrobial Agents

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ABSTRACT. Establishing an accurate diagnosis of bacterial sinusitis is challenging but critical, because viral rhinosinusitis is at least 20 to 200 times more common than bacterial infection of the sinuses. Strict criteria for clinical diagnosis that require either prolonged and persistent symptoms or an acute severe presentation are supported with published evidence.

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Radiographic imaging of the sinuses should be used only in very selected circumstances. A majority of patients with the common cold will meet radiographic criteria for sinusitis early in the course of their illness. For patients meeting these strict criteria, an appropriate narrow-spectrum antimicrobial agent will be of modest benefit compared with symptomatic treatment alone. *Pediatrics* 1998;101:174–177; *sinusitis, diagnosis, antimicrobial therapy, mucopurulent rhinitis, antimicrobial resistance, pediatrics.*

ABBREVIATIONS. URI, upper respiratory tract illness; CT, computed tomography.

PRINCIPLES

1. Clinical diagnosis of bacterial sinusitis requires the following: prolonged nonspecific upper respiratory signs and symptoms (ie, rhinosinusitis and

cough without improvement for >10 to 14 days), or more severe upper respiratory tract signs and symptoms (ie, fever $\geq 39^{\circ}\text{C}$, facial swelling, facial pain).

2. The common cold often includes radiologic evidence of sinus involvement; therefore, radiographs should be used and interpreted with caution. They may be indicated under the following conditions: when episodes of sinusitis are recurrent, when complications are suspected, or when the diagnosis is unclear.
3. Initial antimicrobial treatment of acute sinusitis should be with the most narrow-spectrum agent that is active against the likely pathogens.

BACKGROUND AND JUSTIFICATION

Each year, millions of children are diagnosed with sinusitis and prescribed an antimicrobial agent.¹ It is estimated that most preschool and school children have three to eight acute viral upper respiratory tract illnesses (URIs) annually and that bacterial sinusitis complicates 0.5% to 5.0% of these.²⁻⁴ Uncomplicated viral URIs produce congestion and inflammation of both the nasal and the sinus mucosa; therefore, they should be viewed as viral rhinosinusitis infections.^{5,6} Because viral rhinosinusitis is at least 20 to 200 times more common than bacterial sinusitis, the use of appropriate diagnostic criteria to identify accurately the small subgroup of patients who may have a bacterial infection of the sinuses is a primary goal in promoting the judicious use of antimicrobial agents.

Sinusitis is defined as inflammation of the sinus mucosa. It can be caused by either infectious or noninfectious processes. Episodes of sinusitis may be categorized on the basis of duration of symptoms as acute (symptoms lasting 10 to 30 days), subacute (symptoms lasting 30 days to 3 months), or chronic (symptoms lasting >3 months). The major causative agents differ according to these categories; the principles described here focus on acute sinusitis.

The precipitating event in acute sinusitis is usually a viral upper respiratory tract infection that produces mucosal inflammation.⁷ The inflammation may result in obstruction of the sinus ostia and trapping of fluid in the sinus cavities. Without proper drainage, bacteria that are part of the normal upper respiratory tract flora can be trapped and proliferate in this space. The pathophysiology of acute sinusitis is similar to that of acute otitis media; sinusitis and otitis media may coexist.⁸ In addition, as with acute otitis media, ~60% of sinusitis episodes will resolve or improve spontaneously without antimicrobial therapy.⁹⁻¹¹ By carefully applying specific clinical criteria for the diagnosis of acute sinusitis, it should be possible to limit the use of antimicrobial agents to situations in which they are most likely to be beneficial.

EVIDENCE SUPPORTING PRINCIPLES

Clinical diagnosis of bacterial sinusitis requires the following: 1) prolonged nonspecific upper re-

spiratory signs and symptoms (ie, rhinosinusitis and cough without improvement for >10 to 14 days), or 2) more severe upper respiratory tract signs and symptoms (ie, fever $\geq 39^{\circ}\text{C}$, facial swelling, facial pain).

Judicious antimicrobial therapy for bacterial sinusitis depends on limiting the use of these agents to children who have a high likelihood of benefiting from treatment. Therefore, the diagnosis of bacterial sinusitis should be limited to those children with clinical signs and symptoms that are most likely to reflect true disease. Acute sinusitis among older children and adults occasionally can be diagnosed by the presence of classic signs or symptoms, such as sinus tenderness, tooth pain, headache, and high fever.¹²⁻¹⁴ However, in young children, these classic signs or symptoms are almost never present.

Uncomplicated URIs and bacterial sinusitis may be indistinguishable solely on the basis of the clinical features observed. The duration of the signs and symptoms rather than their mere presence, is most discriminatory in distinguishing these two conditions. Therefore, it is important to review and understand the natural history of URIs.

The natural history of uncomplicated viral URI has been well defined in studies of patients with documented community-acquired viruses as well as in experimentally induced rhinovirus URI among adult volunteers.¹⁵⁻¹⁷ Sore throat and sneezing commonly occur early in the course of illness and tend to resolve over 3 to 6 days. Fever, malaise, and myalgia are reported by a smaller proportion of patients, but also resolve by day 6 to 8. Cough, nasal discharge, and nasal obstruction are common and persist; up to 25% of patients still have these symptoms at 14 days.^{4,15,17} Involvement of the paranasal sinuses, with thickened mucosa, infundibular occlusion, and occasional air-fluid levels, is a consistent aspect of uncomplicated viral URI.⁵

Although some believe that mucopurulent rhinitis (thick, opaque, or discolored nasal discharge) indicates the presence of bacterial sinusitis, this sign should be recognized as part of the natural course of a nonspecific, uncomplicated viral URI. Natural history studies of experimental rhinovirus colds reveal that nasal discharge changes from clear to purulent during the first few days of illness.^{17,18} Furthermore, the color and characteristics of the discharge do not predict whether a bacterial pathogen will be isolated.¹⁸

Acute bacterial sinusitis can be diagnosed in children who have persistent symptoms without improvement by 10 to 14 days; however, children with rhinorrhea or cough that is improving by day 10 of illness are likely to have an uncomplicated viral URI.⁴ Persistent clinical findings usually include nasal discharge and day time cough. The nasal discharge may be of any color or quality (thick, thin, clear, or purulent); thus, the character of the discharge is not helpful in distinguishing sinus fluid infected with a bacterial pathogen from uninfected fluid.^{19,20} Persistent nocturnal cough is nonspecific and may be observed during uncom-

plicated viral URIs. Day time cough is less common and may indicate sinus drainage.²¹

Sinusitis also may be diagnosed among children who have URI accompanied in the first several days by specific signs and symptoms indicative of acute sinus inflammation. These severe signs and symptoms may include high fever ($\geq 39^{\circ}\text{C}$), persistent fever, periorbital swelling, facial pain, or dental pain.²¹ Sinusitis presenting with more severe URI symptoms is much less common than sinusitis presenting with persistent, unimproved URI symptoms.^{7,22}

Even with application of the strict criteria, some children who do not have bacterial sinusitis will be identified for treatment. In a study of 171 children with nasal discharge or cough lasting from 10 to 30 days, 80% had abnormal maxillary sinus radiograph findings.⁹ In another study of the microbiology and treatment of acute maxillary sinusitis, sinus radiography was performed on children 1 to 16 years of age who presented with prolonged respiratory symptoms (ie, nasal discharge or day time cough, or both, for 10 to 30 days without improvement) or severe respiratory symptoms, defined by concurrent fever ($\geq 39^{\circ}\text{C}$) and purulent rhinorrhea for 3 to 4 days. Fifty children met these strict clinical criteria and had abnormal radiographic findings in at least one of their maxillary sinuses. Aspiration of the affected sinuses and culture of the material demonstrated that a bacterial pathogen could be recovered from 70% of these children.²² Taking these studies together, recovery of pathogenic bacteria would be expected from only 56% (ie, $80\% \times 70\%$) of children fulfilling these clinical criteria.

The common cold often includes radiologic evidence of sinus involvement; therefore, radiographs should be used and interpreted with caution. They may be indicated 1) when episodes of sinusitis are recurrent, 2) when complications are suspected, or 3) when the diagnosis is unclear.

Sinusitis is usually a clinical diagnosis; however, in some circumstances radiography of the sinuses may be needed to confirm the clinical impression. Findings of sinusitis on plain films, computed tomography (CT), or magnetic resonance imaging include air-fluid levels, opacification, or mucosal thickening of >4 mm.^{22,23} Normal findings on sinus films make the diagnosis of sinusitis highly unlikely, but abnormal findings are only moderately helpful in confirming the diagnosis of acute bacterial sinusitis, because other conditions including the common cold will result in abnormal radiographic findings.^{19,24-27} CT or magnetic resonance imaging can be used for more detailed examination of the sinuses than that afforded by plain films. Like plain films, these studies are rarely needed in acute infections unless accompanied by intracranial or intraorbital complications. Radiologic investigation should be reserved for specific indications. These include confirming clinical diagnoses of recurrent sinus infections; evaluating children with persistent, complicated, or severe infections; and situations in which sinus surgery is being contemplated.²⁴

Radiographic studies performed early in the course of a respiratory illness are not helpful for diagnosis of sinusitis, because viral infections of the upper respiratory tract can themselves cause mucosal edema, obstruction of the ostiomeatal complex, and fluid accumulation. Patients with uncomplicated viral infections may exhibit not only the same clinical signs and symptoms as those with bacterial sinusitis (eg, pressure, congestion) but the same abnormal radiographic findings as well.⁶ A study of 31 adults evaluated by CT in the first 48 to 96 hours of uncomplicated viral respiratory illnesses showed that almost 90% had abnormalities of one or both maxillary-sinus cavities.⁵ After 2 weeks, these findings resolved spontaneously or improved for 79% of individuals reexamined; none had received antimicrobial therapy.

In young children, the sinuses may not be developed fully, making radiologic findings difficult to interpret. Maxillary and ethmoid sinuses are present at birth, although they are very small. Frontal and sphenoid sinuses begin to appear at ~ 5 or 6 years of age but do not become fully developed until adolescence. In a small proportion of children, the frontal sinuses may not develop at all or may develop only unilaterally. Misinterpreting absent sinuses as opacified sinuses in children and adolescents can lead to overdiagnosis of sinusitis.²⁸ For this reason, sinus films should be interpreted with great caution for children <1 year of age.²⁹

There are no radiographic images that alone confirm a diagnosis of bacterial sinusitis; it is only in the setting of prolonged symptoms suggestive of a bacterial superinfection that radiographic images can support such a diagnosis. Abnormal images reflect inflammation; they do not disclose whether the inflammation is viral,⁵ bacterial,^{19,25} or allergic³⁰ in origin.

Initial Antimicrobial Treatment of Acute Sinusitis Should Be With the Most Narrow-spectrum Agent That Is Active Against the Likely Pathogens

Acute sinusitis is usually caused by the same bacterial pathogens that cause acute otitis media (*Streptococcus pneumoniae*, *Haemophilus influenzae* (usually nontypeable), and *Moraxella catarrhalis*). In studies in which microbiologic agents are identified by culture of fluid aspirated from the maxillary sinuses of children and adults, *S pneumoniae* accounted for 30% to 66% of isolates, *H influenzae* and *M catarrhalis* each for 20%, and viral pathogens alone for $\sim 10\%$ of episodes.^{11,13,19,25} A study of 30 children with clinical and radiographic findings of maxillary sinusitis who underwent aspiration of the maxillary sinus demonstrated recovery of a bacterial agent in 77% and a virus in 7%.¹⁹ Although the bacteria isolated from the sinuses were usually found in the cultures of the nasopharynx, they were not predictably the predominant species, suggesting that nasopharyngeal cultures are not useful to predict the sinus pathogen.

As with acute otitis media, acute sinusitis often will resolve even without antimicrobial therapy. A double-blind, placebo-controlled antimicrobial

treatment trial of children with acute sinusitis (diagnosed by symptoms of 10 to 30 days and radiographic abnormalities) demonstrated that for 50% of the children in the placebo group, symptoms improved by day 3 of treatment and for 60% by day 10 of treatment, compared with 85% and 77%, respectively, of children treated with either amoxicillin or amoxicillin-clavulanic acid.⁹ Similar results have been observed in the three placebo-controlled treatment trials conducted among adults.^{10,11,31} In addition, despite β -lactamase production by some isolates of *H influenzae* and almost all *M catarrhalis*, therapy with amoxicillin still is successful for the initial treatment of acute uncomplicated sinusitis in most children.⁸

For recurrent infections or for patients who do not demonstrate a clinical response in 48 to 72 hours, a β -lactamase-stable agent (eg, amoxicillin-clavulanic acid or β -lactamase-stable cephalosporins active against pneumococcus) or an agent active against penicillin-resistant pneumococci (eg, clindamycin or high-dose amoxicillin) should be considered.³² When children experience a recurrence of symptoms, the practitioner must try to distinguish clinical relapse from another episode of viral URI, with or without a bacterial infection of the paranasal sinuses.

The duration of antimicrobial therapy should be limited to 7 days beyond the point of substantial improvement or resolution of signs and symptoms; this is usually a 10- to 14-day course of treatment. There is no need for more prolonged therapy (ie, 3 to 4 weeks) unless improvement in signs and symptoms is delayed. Although one study of abbreviated courses of antibiotics (ie, <10 days) has been conducted among adults,³³ there have been no systematic studies in children.

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