An Approach to Pediatric Upper Respiratory Infections

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Upper respiratory tract infections are the most common diseases encountered in office pediatrics. The majority of these illnesses, including the common cold and pharyngitis, are viral in etiology, present with rhinitis and fever, and are self-limited and benign. Management consists of fluids, rest, saltwater nose drops and analgesics. Antihistamines appear to relieve only those symptoms potentiated by allergy. With the exception of streptococcal pharyngitis, upper respiratory tract infections do not require antibiotic therapy. However, otitis media and sinusitis, which sometimes are difficult to diagnose, are markedly improved by antibiotics that cover *Streptococcus pneumoniae, Haemophilus influenzae* and *Moraxella catarrhalis.* In 10 percent of children, otitis media and sinusitis are recalcitrant to antibiotic therapy. For these patients, referral to an otolaryngologist, myringotomy, placement of tympanostomy tubes or a short trial of prednisone may be efficacious.

Respiratory diseases account for 50 percent of all acute illnesses in children. The majority of these illnesses are benign, self-limited upper respiratory infections. Nevertheless, they place a great deal of pressure on our economic, educational and health care systems.

Millions of people with upper respiratory infections consume medications frequently, even though the benefits of these remedies are often difficult to confirm. Family physicians need to counsel their patients about the natural course of upper respiratory infections and the relative ineffectiveness of most treatments for these illnesses.

Included in the broad category of upper respiratory infections are a few specific illnesses that may respond to treatment. Of these, otitis media and sinusitis are amenable to treatment, but only a few causes of pharyngitis and rhinitis respond to medication.

Rhinitis

The approach to the child with rhinitis is determined by the history and physical findings. Patient age, duration of nasal discharge, exposure to an infectious agent, historical events such as foreign body insertion and associated complaints such as headache are critical to appropriate management. The presence of cough and fever or the finding of abnormalities on physical examination may provide essential clues to the cause of rhinitis.

The usual causes of rhinitis are listed in Table 1. The more than 100 types of rhinovirus are responsible for 30 to 35 percent of all common colds, but in equal percentage the cause remains unknown. Coronavirus is responsible for about another 10 percent of cases. Treatable or preventable virus infections, such as those due to influenza, rubeola, rubella, varicella or respiratory syncytialvirus, account for only 5 to 10 percent of cases.

Table 1. Causes of Rhinitis

Nasopharyngeal mucosal infection

Common viral causes
- Rhinovirus
- Coronavirus
- Adenovirus
- Respiratory syncytial virus
- Parainfluenza virus
- Influenza virus
- Coxsackie virus
- Epstein-Barr virus
- Rubeola virus
- Rubella virus

Bacterial causes
- *Streptococcus pyogenes*
- *Bordetella pertussis*
- *Corynebacterium diphtheriae*
- *Mycoplasma pneumoniae*
- *Treponema pallidum*
- *Mycobacterium tuberculosis*

Localized infection

Sinusitis
Adenoiditis

Immunologic abnormalities

Allergy
IgA deficiency
IgG or subclass deficiency

Structural defects

Foreign body
Polyps
Septal deviation
Tumor
Congenital (eg, choanal atresia)
Genetic (eg, ciliary dysfunction)

Others

Rhinitis medicamentosa
Facial trauma
Diving into water repeatedly
Inhaled irritants.

Bacterial agents are an uncommon cause of rhinitis, except in children less than three years old. In children this age, group A beta-hemolytic streptococcus may cause mild fever, persistent purulent nasal discharge and cervical adenopathy. These symptoms can last several months. In such cases, nasopharyngeal culture is useful in identifying the causative agent.

Except during infancy when the immune system is poorly developed, chronic rhinitis is most commonly caused by an allergy. Between 5 and 9 percent of children suffer from allergic rhinitis.

Insertion of foreign bodies, such as orange seeds, buttons or pieces of foam rubber, into the nose is common in toddlers. A particularly foul-smelling odor or discharge (ozena) emanating from one nostril should alert the physician to the possibility of foreign-body impaction.

Most children with acute rhinitis have a common cold. Associated cough, sneezing, sore throat, myalgia, malaise and headache are usually present. Because of the cough, some children develop anorexia or vomiting.

On physical examination, children with acute rhinitis may be mouth breathing and may appear toxic. Enlarged cervical lymph nodes, mild tearing, mild conjunctival injection and fever are common. Temperature, however, is usually not above 38.5°C (101.3°F). The nostrils may be blocked from mucosal swelling or mucus. In most cases, the nasal discharge is first watery, then mucoid with a change to yellow or green coloring and, finally, watery again as the cold resolves. Symptoms generally last two to seven days and resolve by two weeks, depending on the etiologic agent.

During the early months of life, infants are protected from colds by transplacental maternal antibodies and limited exposure to other individuals. To some extent, breast-fed infants are protected by antiviral agents in their mothers' milk. After the age of six months, depending on the extent of exposure, infants may have six to 10 colds a year.

Because children generally contract cold viruses from other children, day care enrollment and large family size generally increase the number of infections a child may have. The winter prevalence of many viral illnesses is a reflection of crowding and increased exposure. Adult habits, such as smoking and failure to wash hands between touching different children, also promote infection. The incubation period for most viruses is one to seven days.

Treatment

Symptom control is basically all that can be accomplished for the common cold. For patients with allergies, antihistamines have been shown to be helpful. Some evidence suggests that these agents, as well as decongestants, lessen sneezing, nasal blockage and nasal discharge.

Improved fluid intake may reduce the viscosity of mucus, which may ease coughing and nasal congestion. Saltwater nose drops or sprays are safe and effective for liquefying nasal

mucus. Some authorities recommend the use of cold-mist vaporizers.

Acetaminophen is primarily useful for temperature control and pain relief. Because of fears about Reye's syndrome, aspirin is not recommended for children and adolescents. The role of other agents, such as ibuprofen, has yet to be delineated. Cough suppressants containing dextromorphan or diphenhydramine may help quiet cough.

A few specific therapies are available. Amantadine (Symmetrel) prevents or improves influenza A infection, and infections with respiratory syncytial virus respond to ribavirin (Virazole). However, side effects and cost limit widespread use of these drugs. Similarly, topical intranasal alfa$_2$-interferon has shown some promise in lessening rhinoviral infection. Steroid sprays can markedly reduce the infection rate for allergic patients and may benefit patients with other types of rhinitis. However, the major preventive measure is washing the hands with soap and water after contact with the mouth, nose or eye.

Cold viruses appear to predispose a person to more localized infections, including pneumonia, conjunctivitis and cervical adenitis. Pharyngitis, the most common simultaneous infection, is difficult to treat, but is usually self-limited. Persistent purulent rhinorrhea lasting more than 10 days can be a sign of adenoiditis, which responds to beta-lactamase-resistant antibiotics, such as amoxicillin-clavulanate potassium (Augmentin) cefaclor (Ceclor).

At least 2 percent of colds are accompanied by otitis media, and at least 0.5 percent are accompanied by sinusitis. These infections are treatable, because they are primarily bacterial in origin.

Otitis Media

Seven out of 10 children less than six years of age suffer at least one episode of otitis media, one out of three have recurrent bouts, and five to 10 out of 100 develop chronic middle ear inflammation. Children who have otitis media in the first year of life are more likely to suffer from chronic infection. Children with allergies, Down syndrome, cleft palate or acquired immunodeficiency syndrome, as well as children whose parents smoke, are also at increased risk.

The tympanic membrane is only two cell layers thick. When the physician looks through this semitranslucent window, visualized fluid may be serous, purulent or mucoid in a patient with otitis media. Not only may the fluid itself be infected, but the mucosal surface of the middle ear may also be inflamed. When the eustachian tube fails to ventilate the middle ear cavity, either because of blockage or dysfunction, bacteria grows in the mucosal layer, fluid is exuded and pus forms. Acute otitis media is then present.

After appropriate treatment or natural improvement, some children still have fluid in the middle ear. If middle ear infection develops again, the illness is considered recurrent. If the fluid persists beyond three months, the illness is termed chronic otitis media with effusion.

The most frequent bacterial causes of acute otitis media are *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Moraxella catarrhalis.* In 5 to 30 percent of *H. influenzae* infections and in 75 percent of *M. catarrhalis* infections, the organisms produce enough beta-lactamase to potentially limit antibiotic choice. Effusions may also be the result of chlamydial, anaerobic or viral infections. Respiratory syncytial virus, rhinovirus, influenza virus and other agents have been cultured from middle ear fluid.

Ear pain is the most common presenting symptom of otitis media. Symptoms of a concurrent upper respiratory infection may be present. Infants usually develop fever and irritability, but gastrointestinal symptoms may predominate. Older children may have hearing loss.

Pneumatic otoscopy is helpful in diagnosing otitis media. Visual clues, such as loss of landmarks, bulging of the eardrum and the presence of fluid or bullae are augmented by the finding of abnormal eardrum mobility. A tympanogram can confirm or refute the physical findings.

Treatment

Acceptable antimicrobial therapies for otitis media are listed in Table 2. As many as 45 to 50 percent of patients improve without antibiotics. Amoxicillin and trimethoprim-sulfamethoxazole (Bactrim, Septra), which are inexpensive and have few side effects, remain the drugs of choice for otitis media. Fluid sterilization usually requires 10 to 14 days of amoxicillin therapy, but most patients improve within 48 hours.

All of the antimicrobial agents used to treat otitis media have potential side effects. Most cause diarrhea, which is particularly common with amoxicillin-clavulanate potassium. Cefaclor can produce a serum-sickness-like drug reaction. Erythromycin can produce gastric upset, while erythromycin-sulfisoxazole (Pediazole) and trimethoprim-sulfamethoxazole can cause bone marrow suppression.

Taste tests give an edge to the cephalosporins. Cefuroxime axetil (Ceftin) is available only as a tablet and is not well tolerated by small children, even if the tablet is crushed and mixed with sweet foods.

For the full adult dose, 10 days of amoxicillin cost as little as $8, while a course of amoxicillin-clavulanate potassium, cefaclor, cefixime (Suprax) or cefuroxime can cost a great deal more. Trimethoprim-sulfamethoxazole costs about $7, while erythromycin-sulfisoxazole costs $18 for generic medication.

Even with appropriate treatment of otitis media, persistent middle ear effusion is present in 40 percent of children one month after the initiation of antibiotic therapy. At two months, 20 percent of treated children still have effusion. At three months, effusion remains in 10 percent of children with otitis media treated with antibiotics. The use of decongestants and antihistamines does not alter these percentages, except perhaps to worsen them.

Persistent effusion may affect hearing, thereby impairing cognitive function. Myringotomy without the placement of tympanostomy tubes can be helpful, but some children requires tubes to ventilate the middle ear, restore hearing and diminish the risk of recurrent otitis media. However, tube placement carries a number of risks, including the risk of anesthesia, otorrhea and a tympanic membrane that may be scarred, chronically perforated or prone to cholesteatoma formation. With tube placement comes the potential for water-borne infection with an organism such as *Pseudomonas aeruginosa.* Therefore, tube placement should be considered only for children with bilateral effusion persisting more than 90 days and associated with hearing loss.

Table 2. Treatment of Otitis Media and Sinusitis in Children

Agent
Dosage
Usual maximum dose per day

Amoxicillin
40 mg per kg per day in three divided doses
750 mg
Trimethoprim-sulfamethoxazole (Bactrim, Septra)
8/40 mg per kg per day in two divided doses
1.600 mg sulfamethoxazole
Erythromycin-sulfisoxazole (Pediazole)
50/150 mg per kg per day in four divided doses
1.000 mg erythromycin
Cefaclor (Ceclor)
40 mg per kg per day in two or three divided doses
750 mg
Amoxicillin-clavulanate potassium (Augmentin)
40 mg per kg per day in there divided doses
750 mg
Cefuroxime axetil (Ceftin)
125 mg twice daily in children under two years of age
250 mg twice daily in children older than two years of age
500 mg
Cefixime (Suprax)
8 mg per kg per day once daily
400 mg.

Recent evidence indicates that a seven-day course of prednisone, 0.5 to 1.0 mg per kg twice daily, with 30 days of trimethoprim-sulfamethoxazole can resolve up to 70 percent of chronic middle ear effusions. Adenoidectomy may also be efficacious.

Prophylaxis should be considered for children with recurrent bouts of otitis media (three episodes in six months or four episodes in 12 months). Effective prophylaxis has been achieved

with amoxicillin, 20 mg per kg once daily, or sulfisoxazole (Gantrisin), 75 mg per kg in two divided doses per day, with each medication given for up to six months.

Sinusitis

The major difficulty with sinusitis is diagnosis. At birth, only slit-like maxillary sinuses are present. These and the ethmoid sinuses slowly develop over the first two to three years of life. After the sixth year, the frontal sinuses can be infected, although this is uncommon before age 10.

Acute sinusitis is more severe than a cold. It is characterized by fever, copious purulent nasal mucus and facial pain, usually with headache, cough and periorbital swelling. Chronic sinusitis produces nasal discharge of various types and daytime cough, both of which last longer than 10 days. The urge to make a clinical diagnosis of sinusitis in the absence of these symptom constellations must be avoided.

Confirmatory tests for sinusitis include transillumination, radiography (including computed tomographic (CT) scanning and sonography) and sinus aspiration. In older children, transillumination may be useful for detecting frontal or maxillary sinusitis. Radiographic signs include mucosal thickening of 4 mm or greater, air-fluid levels or generalized cloudiness. Radiographs of infants are less reliable, because crying may cloud the sinuses. CT scanning can provide definitive evidence of sinusitis, but it is too expensive for routine application. When the clinical picture of sinusitis is confirmed radiographically, only 70 percent of maxillary sinus aspirations yield bacteria or pus.

About 0.5 percent of colds are accompanied by sinusitis. Children with allergic rhinitis have a 70 percent risk of developing sinusitis. Septal deviation, dental abscess, foreign bodies, polyps, facial trauma, tumors, immunodeficiency and mucociliary dysfunction all predispose patients to sinusitis.

The agents that cause sinusitis are similar to those that cause otitis media. Forty percent of cases of sinusitis are caused by *S. pneumoniae,* 15 percent by *H. influenzae* and 15 percent by *M. catarrhalis.* A small percentage of cases are caused by *Eikenella corrodens,* peptostreptococcus or other anaerobes, and by group C or group A beta- or alpha-hemolytic streptococcus. This same bacterial spectrum has been recovered from the sinus fluid of patients with sinusitis that has persisted up to 90 days. After that time, anaerobes such as Bacteroids and Fusobacterium species are more common. Viruses have also been cultured from sinus fluid.

Treatment

The antibiotics listed in Table 2 are efficacious in sinusitis. Generally, amoxycillin is the drug of choice, but other agents are equally satisfactory, barring cost.

In some cases, therapy must be continued beyond the 10 to 14 days usually recommended, sometimes for up to six weeks. However, 75 percent of children show marked improvement within 48 hours after the initiation of therapy. By 10 days, about 40 percent of untreated patients improve, compared with 65 percent of those treated with either amoxicillin or amoxicillin-clavulanate potassium.

The precise role of topical or oral decongestants and antihistamines is unclear, but studies to date have not supported their use. Analgesics and saltwater nose drops help relieve symptoms.

Besides providing symptom relief, the major rationale for treating sinusitis is to prevent serious suppurative complications. Preseptal or postseptal orbital cellulitis, cavernous sinus thrombosis, meningitis, brain abscess, sepsis and frontal bone osteomyelitis are some of the serious conditions that facial infections can produce.

Pharyngitis

Although acute pharyngitis is self-limited, it may be severe. However, the potential for the development of acute rheumatic fever after streptococcal pharyngitis often prompts physicians to prescribe antibiotics that may be of little benefit.

The agents believed to produce pharyngitis are categorized in Table 3. The only agent that is both common and treatable is group A beta-hemolytic *Streptococcus pyogenes*, which is responsible for 10 to 20 percent of the cases of childhood pharyngitis. Almost all other causes of pharyngitis in children are self-limited, benign viral infections. In some instances, smoking, allergy, mouth breathing or environmental inhalants play a more important role than infection.

Viral infection occurs in persons of all ages. Group A beta-hemolytic streptococcal infection is prevalent in the five-to-17-year-old group, but it is not common before age three and rarely produces acute rheumatic fever prior to that age. During the epidemic winter months, up to 60 percent of eight- to 12-year-olds with fever, exudative pharyngitis and cervical adenopathy have group A beta-hemolytic streptococcal infection.

Children with acute pharyngitis may present with abdominal pain, headache and fever, or they may simply complain of a sore throat. With a history of exposure to group A beta-hemolytic *S. pyogenes,* a temperature above 38.8°C (101.8°F), enlarged, tender cervical lymph nodes and exudative pharyngitis, group A beta-hemolytic streptococcal infection is the likely cause of illness.

Scarlet fever rash is almost uniformly due to group A beta-hemolytic streptococcal infection. Unfortunately, cases of acute rheumatic fever have been linked to nearly asymptomatic group A streptococcal pharyngitis. Recently, many individuals with acute rheumatic fever have not felt ill enough to visit a physician.

Table 3. Causes of Pharyngitis in Children

Common viral causes

Rhinovirus
Coronavirus
Adenovirus
Herpes simplex virus
Influenza virus
Parainfluenza virus
Coxsackievirus
Epstein-Barr virus
Cytomegalovirus

Bacterial causes

Common proven agents
- Group A beta-hemolytic
  - *Streptococcus pyogenes*

Less common proven agents
- Group G or group C *S. pyogenes*
- *Neisseria gonorrhoeae*
- *Corynebacterium haemolyticum*
- *Corynebacterium diphtheriae*
- *Corynebacterium ulcerans*
- Mixed anaerobic infection
  - *Treponema pallidum*
  - *Yersinia enterocolitica*

Unlikely but putative agents
- *Mycoplasma pneumoniae*
- *Mycoplasma homminis*
- *Chlamydia psittaci*
- *Chlamydia trachomatis*
- *Staphylococcus aureus*
- *Haemophilus influenzae*
- *Moraxella catarrhalis*

Others

- Tumor
- Trauma
  - Foreign body
  - Inhalants
  - Chemical
  - Temperature aberrations
- Localized infection
  - Tonsillitis
  - Uvulitis
- Allergy
- Abscess
  - Retropharyngeal
  - Lateral pharyngeal
  - Peritonsillar (quinsy)
- Referred pain (eg, subacute thyroiditis)
- Immunologic deficiency
  - Neutropenia
  - Collagen vascular disease
    - Systemic lupus erythematosus
    - Behçet's syndrome
- Kawasaki syndrome
- Chronic fatigue syndrome (primarily in adolescents)
- Medication sensitivity.

Pharyngitis due to bacteria other than group A beta-hemolytic *S. pyogenes* is uncommon. Rarely, gonococcal pharyngitis is found in sexually active adolescents. Diphtheria remains a problem in other parts of the world, and outbreaks of *Corynebacterium haemolyticum* infection have occasionally occurred in Swedish adolescents. Group C or group G streptococcus may produce prolonged pharyngitis.

The classic presentation of Epstein-Barr virus infection (infectious mononucleosis) mimics that of group A beta-hemolytic streptococcal infection. Small vesicles on the tonsils, palate and uvula suggest herpangina due to coxsackievirus infection. In general, the presence of cough, coryza and hoarseness favors a viral etiology for pharyngitis.

Treatment

Sore throat and other symptoms of pharyngitis may be relieved with warm saltwater gargles; analgesics such as acetaminophen, aspirin or nonsteroidal antiinflammatory drugs; topical anesthetic agents such as viscous lidocaine (Xylocaine), throat lozenges or gargled liquid diphenhydramine, and the ingestion of warm fluids. Antiseptic mouth washes are occasionally beneficial.

Antibiotic therapy is required for infections with group A beta-hemolytic *S. pyogenes* and the other bacterial agents listed in Table 3. These infections respond to penicillin V, 10 to 15 mg per kg (maximum dose: 250 mg) four times daily for 10 days or, for those who are allergic to penicillin, erythromycin, 10 mg per kg (maximum dose: 250 mg) four times daily.

The failure of penicillin to eradicate group A beta-hemolytic *S. pyogenes* in 15 percent of cases has led some experts to recommend the use of erythromycin or cephalosporins such as cephalexin (Keflex) as first-line agents.

Of special interest are those patients who present with acute tonsillitis that may be unrelated to group A beta-hemolytic streptococcal infection. If these infections are recurrent and difficult to eradicate medically, some patients benefit from tonsillectomy. Retropharyngeal, lateral pharyngeal and peritonsillar abscesses must be recognized and drained.

Some viral syndromes, especially those due to Epstein-Barr virus, respond to systemic steroids. Several studies have shown that steroids for mononucleosis are safe and effective in college students. Older children who cannot swallow and are extremely ill with infectious mononucleosis may benefit from five to seven days of steroid therapy.

Final Comment

Since upper respiratory infections are such an important focus of office practice, family physicians need to be familiar with the clinical course and treatment of these diseases. Use of antibiotics for upper respiratory infections should be carefully considered and should be targeted at specific nonviral agents.