

**CHAPTER 10**

ACUTE RESPIRATORY INFECTIONS OF THE UPPER RESPIRATORY TRACT

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I. ACUTE STREPTOCOCCAL PHARYNGOTONSILLITIS

Hemolytic streptococci, particularly group A (*Streptococcus pyogenes*), are the most common infectious bacteria in humans and cause a broad and variable symptomatology. Primary infections often present tonsillitis, pharyngitis, scarlet fever, bronchitis, pneumonia, erysipelas, and cellulitis. Septic complications include cervical lymphadenitis, otitis media, sinusitis, mastoiditis, meningitis, empyema, peritonitis, and endocarditis. This agent may also cause rheumatic fever and acute glomerulonephritis, secondary either to pharyngotonsillitis or a skin infection (impetigo).

Moreover, some types of meningitis and acute respiratory syndromes in newborns result from the group B β -hemolytic streptococcus, as do certain infections of the female urogenital tract (1). Group D organisms are also common in humans. Normally, they are found in the gastrointestinal and genitourinary tract, in the skin where they cause infections, and in subacute infectious endocarditis. Streptococcus groups C, G, and F frequently colonize the pharynx and sporadically produce upper respiratory tract infections.

a) Clinical presentation

Children between the ages of 7 and 15 years are the most susceptible to having streptococcal pharyngitis. The purulent exudate from pharyngotonsillitis found in children under 3 more likely presents adenovirus, if not diphtheria.

Randolph et al. (2) describe the clinical characteristics of streptococcal infection according to age group:

Nursing 3 months to 1 year	Preschool 1 to 4 years	School-Age
<ul style="list-style-type: none"> • Irritable but not acutely sick; • low, irregular fever; • serous nasal discharge; • excoriated nostrils; • dramatic response to penicillin. 	<ul style="list-style-type: none"> • Fever, vomiting, stomachache; • nasal speech without mucoid rhinorrhea; • characteristic bad breath; • postnasal mucous discharge; • diffuse pharyngeal redness; • pain in opening mouth; opains in anterior cervical ganglia; • otitis media often present. 	<ul style="list-style-type: none"> • Sudden onset of fever (90%), headache (50%); • local and systemic signs tapering off after 24 hours; • pharynx with moderately diffuse to extreme redness; • red tongue with swollen papillae; • reddened soft palate; • painful swallowing; • exudate on tonsils or pharynx (29%); • lymphatic ganglia swollen and sore in anterior cervical area.

In a study on streptococcal pharyngotonsillitis recently conducted in Mexico, 80% of the sample consisted of children between the ages of 3 and 12 years. The most frequently found symptoms were sore throat (76%), general discomfort (72%), dysphasia (70%), and stomachache. The most apparent signs were redness in the pharynx (86%), painful swelling of the lymph glands (50%), fever above 38.3° C (48%), pharyngeal exudate (46%), blotches on palate (26%), and scarlatiniform eruptions (6%) (3, 4).

This same study found that patients with purulent exudate were more likely to present elevated antistreptolysin O (ASLO) and positive C-reactive protein than were patients with streptococcal pharyngotonsillitis who had no exudative reaction. Of 23 patients with purulent exudate, 17 (74%) had fever above 38.3° C, whereas only 7 of the 27 patients without purulent exudate (26%) had fever.

b) Diagnosis

b.1) Nonspecific laboratory aids

- Leukocyte count: Leukocyte counts below 12,500 are rarely found in streptococcal infections. The greater the number of white globules (within certain limits), the greater the likelihood of finding a pharyngeal culture positive for group A β -hemolytic streptococcus. As with other bacterial infections, the percentage of seg-

mented and rod neutrophils rises in the acute phase of infection and returns to normal during the recuperation phase.

- C-Reactive protein (CRP): If CRP is positive in a patient who presents a clinical picture for streptococcal pharyngotonsillitis, there is greater likelihood that a streptococcus in the pharynx is causing a true infection and that it is not simply in a carrier state. Some authors maintain that a true infection, as opposed to a carrier state, is found only when there is a clear elevation in the antistreptolysin O (ASLO).

b.2) Tests to demonstrate a recent streptococcal infection

- Throat culture: Regardless of the above, it is recommended that a throat culture be taken from all patients with acute pharyngitis, even though the symptoms and signs are observed as typical of the disease. Consideration should be given to the cost, the fact that not all localities have laboratories that can process the samples, and that it is not always possible to obtain reliable lab results.
- ASLO and other antibodies: ASLO titers above 250 are found in 78% to 92% of the cases of pharyngotonsillar streptococcal infection leading to rheumatic fever (5). As stated above, elevated levels of this antibody have been shown to be more likely when there is purulent exudate (65%) than when there is not (52%). The same ratio obtains for fever and positivity for C-reactive protein. These cases are those that in theory are most likely to become compounded by rheumatic fever, although in epidemic situations with especially virulent strains (M-18) such as the Utah epidemic, there were reports of asymptomatic patients with this complication, who had elevated antibody titers (6).

There is no information available from studies on “normal” ASLO titers. Nevertheless, titers have been commonly observed to reach levels of 500 or greater in the wake of a noncomplicated streptococcal pharyngotonsillitis, which is why an anti-streptolysin titer of 250 units is not considered elevated in a child, even though it is in an adult (7). An elevated reading in a child 5 years of age or older would have to be at least 333 units or higher. Generally between 60% and 75% of children with positive throat cultures have elevated ASLO, but elevation is also found in 10% of symptomatic children with negative throat cultures.

Moreover, in the last few years other antibodies have been used against extracellular streptococcus products. These include anti-nicotinamide-adenine dinucleotide (anti-NAD, formerly known as anti-DPN or anti-diphosphopyridine nucleotide) and anti-deoxyribonuclease B (anti-DNAse B).

These antibodies are easier to determine and replicate in the laboratory than are anti-hyaluronidase (AH) or anti-streptokinase (ASK). It is particularly important to determine whether anti-DNAse B remains elevated longer than other antibodies do, to

diagnose cases of Sydenham's chorea (or St. Vitus' Dance) in which there are three months of latency between the time of infection and the onset of symptoms. Other antibodies, however, may remain negative in these same cases (8).

ASLO titers begin to rise in the first week of throat-and-tonsil infection, peak between weeks 3 and 5, and remain elevated for 2 or 3 months thereafter, when they begin to fall gradually until they become "negative" if no new infections appear.

c) Treatment

c.1) Penicillin therapies

A single injection of penicillin G benzathine is the "gold standard" for streptococcal pharyngitis, and it offers the additional advantage of ensuring compliance with physician's instructions, which are normally difficult to follow when using short-duration penicillin. Given how painful the injection point becomes, physicians are reluctant to prescribe this preparation, but the addition of procaine penicillin to the injection significantly reduces the discomfort.

In Mexico, streptococcal pharyngitis has been treated with penicillin G benzathine mixed with 300,000 units of procaine penicillin and 300,000 units of penicillin G protease (Bencetazil® compound, Wyeth). A recent study indicated that when 600,000 units of this compound was administered to a sample of children under 6 and 1.2 million to children over 6, clinical and bacteriological success was 98% and 88%, respectively. (Clinical success was defined as the complete disappearance of signs and symptoms within 10 days of initiating therapy with no relapse before day 21. Bacteriological success was defined as the disappearance of streptococcus by day 11 after treatment, with no recurrence by day 21.)

c.2) Recommendations for treatment with penicillin injections

- A single injection of 600,00 units of penicillin G benzathine compound for children 6 and under.
- Two injections of 600,00 units of penicillin G benzathine compound for children 6 and over, administered at the same spot in children with greater muscle mass or in two different spots when mass is lower.
- Treatment should not be repeated monthly, in the absence of any evidence that after the initial treatment, streptococcus is eradicated when other long-lasting doses of penicillin are administered over a period of subsequent days, weeks, or months. Furthermore, a risk exists of a secondary allergic reaction to subsequent administrations.
- If scarlet fever is diagnosed, it is advisable to repeat one single time the initial treatment chosen on the basis of the patient's age on day 10 after the first injection.

This course is justified by the percentage of children observed to suffer bacteriological failure (about 30%) as compared with a 12% rate of biological failure in cases of streptococcal pharyngitis without manifestations of scarlet fever (9).

The advantages of a single treatment of long-lasting penicillin G benzathine (preferably as a compound) are as follows:

- When one or two single doses, depending on the age, are administered, treatment is completed at the time of the injection.
- Following medical instructions is made easier by the dramatic reduction in the number of injections.
- From the public health perspective, the task of the physicians in the medical service or those working in health centers is greatly simplified, because the dose can be directly administered by the physician or nurse.
- Costs are greatly reduced (for example the cost of 10 injections of procaine penicillin or of 20 days' oral penicillin are similar to that of 1 or 2 injections of penicillin G benzathine).
- The levels obtained by an intramuscular injection of 600,000 units of penicillin G benzathine are from 0.03 to 0.20 unit per ml of plasma over a period of 10 to 14 days in all patients. These concentrations are more than enough to inhibit streptococcal growth, which can be achieved with concentrations as low as 0.005 µg of penicillin per ml. The average peak concentrations obtained after injection of penicillin G benzathine combined with 300,000 units of procaine penicillin after 1, 2, 3, 4, and 24 hours are far superior to those obtained when penicillin G benzathine is used alone, without procaine (10).

c.3) Oral penicillin

Often the physician prefers to prescribe oral penicillin to treat streptococcal pharyngitis to avoid the discomfort brought on by an injection and the danger of an important allergic reaction, even though such reactions in these circumstances are usually infrequent and mild. When this kind of therapy is prescribed, 200,000 units of oral penicillin G four times a day for 10 days is recommended, although it has been found that doubling the size of the dosage and administering it twice a day yields the same effect (11). On the other hand, increasing the dosage to 800,000 units twice a day does not increase the probability of successful treatment (12).

The other option is 250 mg of oral penicillin V three times a day for 10 days, or double the dosage of the drug to 500 mg and administer two times a day. Both therapies have an 85% rate of therapeutic success. As mentioned earlier, the fewer the number of doses or injections, the greater the likelihood of strict adherence to the prescription (13).

c.4) Antibiotics not advised due to ineffectiveness or cost

Tetracyclines are not recommended for eradicating streptococcus from the pharynx. It is well known that a high percentage of these germs are resistant to this antibiotic. Trimethoprim-sulfamethoxazole (TMP-SMX) is not effective (14) nor are sulfonamides. The percentage of bacteriological failures associated with the use of ampicillin or amoxicillin is slightly higher than that obtained with penicillin G or V.

It has been argued that cephalosporin-type antibiotics lead to fewer bacteriological failures than does penicillin. Nevertheless, the differences are small, and the results from these studies are not conclusive (15). A recent publication indicated that a 30 mg/kg dose of cefadroxil one time a day for 10 days is more effective than 250 mg of penicillin V three times a day over the same period (16).

c.5) General recommendations for treatment

- Treat symptomatic patients who yield a positive culture.
- Do not administer antibiotics to individuals who present a pharyngeal symptomatology but negative cultures, unless the pharyngeal indicators are classic and reveal elevated titers of ASLO.
- It is suggested by recent evidence (1993) that an individual identified as a carrier of group A streptococcus does not require antibiotic therapy. To demonstrate carrier status, the ASLO should be under 250 units as determined on two separate occasions with an interval of at least 4 weeks.
- Some exceptions to the general rule of avoiding follow-up treatment have been suggested for cases in which streptococcus persists after appropriate antibiotic therapy or when a carrier has been individually identified. Second treatment is then prescribed if:
 - the streptococcus has been transmitted to other individuals by the child who is the carrier;
 - an epidemic of streptococcal tonsillitis breaks out in a closed or semiclosed community (e.g., at a day-care center);
 - the family is very anxious because even though the child is asymptomatic after appropriate therapy, streptococcus remains present in the child's pharynx;
 - there is a case of rheumatic fever in the family of the index case;
 - the fact that streptococcus persists in the child's pharynx is being used as a pretext and sole indication for performing a tonsillectomy.
- The decision to eliminate streptococcus from the pharynx should not ignore that repeating the initial penicillin treatment, orally or intramuscularly, will not in most cases eliminate the carrier condition or streptococcus obtained from bac-

teriological failure. In these cases, special therapies should be administered such as penicillin in combination with rifampicin.

- There is an important distinction between the carrier who gives no evidence of immune response in the presence of streptococcus and the individual who although he or she remains asymptomatic nevertheless has a true infection (as determined by elevated antistreptococcal antibodies or rheumatic fever present without prior pharyngotonsillitis. Unfortunately, the latter type of case is revealed by complications that present.

d) Nonstreptococcal pharyngitis

Other etiological agents of nonstreptococcal pharyngitis that have been identified appear in Table 2 (17):

Table 2. Viral and other agents involved in nonstreptococcal pharyngitis	
•	Type A coxsackievirus
•	Type B coxsackievirus
•	Herpes simplex virus
•	Adenovirus
•	Echovirus
•	Influenza virus
•	<i>Mycoplasma hominis</i> type 2
•	<i>Corynebacterium diphtheriae</i>
•	<i>Francisella tularensis</i>
•	Infectious mononucleosis (Epstein-Barr virus)

To determine whether the pharyngitis is of viral origin, the clinic should first consider the patient's age. Pharyngitis in a child under 3 is not usually streptococcal in origin (18); streptococcal pharyngitis usually presents in children between 5 and 17 years of age (19). Adenovirus is the most frequent cause of nonstreptococcal pharyngitis. Typical manifestations are fever, lack of clinical response to penicillin therapy, extensive exudate over the tonsils, and a negative culture for group A streptococcus. Frequently, congestion, nasal secretion, mild cough, and whitish round spots below the tonsil mucus are observed. Some children have a necrotic-looking exudate resembling that which is sometimes observed in patients with infectious mononucleosis. Adenovirus types 1, 2, 3, 5, and 7 comprise over 85% of all adenovirus infections.

Next in order of importance as a cause of nonstreptococcal pharyngitis is the herpes simplex virus, whose typical clinical manifestations are fever, sore throat usually accompanied by round white ulcerations on the palate and anterior fauces, and swollen, painful lymph glands. It is important for the physician to carefully examine the tongue, gums, and buccal mucus within a few days to detect ulcers that might not have been discovered in the initial examination. In some

patients at the onset of the disease, pharyngeal exudate or sores are observed, complicating diagnosis of herpes stomatitis.

Type A coxsackievirus can often be isolated from an ulcerated pharynx. The typical clinical manifestations are identical to those originally described for herpangina: small vesicular or ulcerated lesions in the pharynx, the latter with a red areola, without evidence of stomatitis and usually observed in summer and autumn. If pharyngeal exudation is observed in a preschooler, but without vesicular or ulcerative lesions, adenovirus is the most likely cause and not type A coxsackievirus. Echovirus and type B coxsackievirus cause mild pharyngitis, usually without exudation, and a nondifferentiated fever.

Infectious mononucleosis may be associated with exudative pharyngitis, even though this disease is systemic and not confined solely to the pharynx. As a result, an attempt should be made to find other signs and symptoms associated with pharyngitis, such as lymphadenopathy, splenomegaly, alteration in hepatic tests, and atypical lymphocytes (more than 15%) (20).

Type I *Mycoplasma hominis* is a rare cause of pharyngitis in children, presenting mild exudative pharyngitis. In a recent study (21) *Mycoplasma pneumoniae* was cultivated from 7 of 140 children (5%) with acute pharyngitis, but the same incidence was found in nonsymptomatic children. Likewise, *Chlamydia trachomatis*, the agent indicated as the cause in as many as 20% of the pharyngitis cases in adults (22), was not isolated from children between the ages of 1 and 12 years who had acute pharyngitis.

Thus, it can be concluded that these microorganisms do not represent a problem in the etiology of childhood pharyngitis, and that therefore the first consideration in receiving one of these cases is to detect and treat group A β -hemolytic streptococcus.

II. ACUTE OTITIS MEDIA

a) Definitions

Otitis media is defined as an inflammation of the middle ear and is classified in the following way (23):

- a.1) Acute suppurative otitis media (acute otitis media, otitis media purulenta acuta) erupts suddenly and passes quickly. It is characteristic to have a middle-ear infection behind a reddened eardrum.
- a.2) Otitis media with drainage (also known as chronic otitis media with drainage, nonsuppurative otitis media, otitis media catarrhalis, mucosis otitis, serous otitis media, secretory otitis media). Of these terms, the last two and otitis media with drainage are most commonly used to refer to nonsuppurative or clinically non-infectious otitis media.

b) Incidence and epidemiology

Acute otitis media (AOM) is usually diagnosed among children. It is most common between the ages of 6 and 36 months, with a lower peak between years 4 and 7. Teele et al., observing

2,565 children up to 3 years of age, found that 71% suffered at least one attack of AOM during the first 3 years and 33% suffered three or more episodes. After the first episode, 40% had drainage from the middle ear that persisted for four weeks, whereas 10% still had drainage three months after the original episode (24).

c) Risk factors

Children who are more susceptible to AOM attacks (six or more episodes) normally have two risk factors in common: 1) the initial infection is caused by pneumococcus, and 2) the disease presents for the first time at 1 year of age (25). Infants who are bottle-fed while in a supine position are more susceptible to an attack of AOM than are breast-fed children, who are generally sustained in a semi-upright position (26). Other authors (27) have found that an indicator of recurrent otitis media (defined as five or more episodes in the first 2 years of life or as four or more in year 2) is the existence of atopy, which is defined as the presence of dry and pruritic dermatitis, urticarial eruption, three or more episodes of bronchitis with wheezing, or one of the three following symptoms: rhinorrhea lasting over 1 month; itching or watery eyes; two episodes of bronchitis with wheezing or gastrointestinal symptoms occasioned by food.

Other identified risk factors of otitis media are attendance at a day-care center, swollen adenoids, passive smoking, and particularly allergies to foods. Additional factors include the child's sex; (male children are significantly more susceptible) (28) and conditions associated with cleft palate, cases that universally present at least one attack of otitis media prior to correction of the problem (29).

d) Pathogenesis

A normal function of the eustachian tube appears to be the most important factor in the pathogenesis of this disease. According to Bluestone (30), there are two kinds of dysfunction in the eustachian tubes that can lead to otitis media: obstruction and abnormal permeability.

Obstruction may be functional or mechanical. Functional obstruction may be the result of a persistent collapse of the tube due to hyperelasticity, an active mechanism of inadequate aperture, or both. This disturbance is common in children and nursing infants because the tensor muscle of the soft palate (the only muscle acting directly on the eustachian tube) is far less efficient prior to puberty.

e) Clinical presentation

Feigin et al. (31) as well as other authors have divided the natural history of otitis media into several stages. Tubotimpanitis, the earliest stage, is produced by obstruction of the eustachian tube. Upon exploring the middle ear, the light reflection and mobility of the tympanic membrane is observed to be diminished when external pneumatic pressure is applied (see pneumatic otoscope below). Serous drainage may occur and the membrane can become withdrawn. The malleus may be in a more horizontal position and its lateral apophysis is more prominent. Light reflection may disappear altogether, and the membrane may become less transparent or

opaque. In the hyperemia stage the patient undergoes symptoms of general discomfort, fever above 39° C, and earache. Further exploration reveals congested vesicula around the edge of the tympanic membrane. The blood vessels appear prominent in the superior external auditory canal, and they run to the malleus from the vascular pedicle. The reference points along the tympanic membrane are still visible, but they have lost their transparency. Movement with the pneumatic otoscope is still present, but pain is absent. There is also a decrease in hearing and a sensation that the ear is "full."

e.1) Exudate stage

The presuppurative stage is characterized by high fever, nausea, vomiting, and anorexia. There may be general malaise, general muscle pain, and even occasional diarrhea. Pain may be so severe that the child awakens from sleep or is prevented from sleeping. The tympanic membrane is red, particularly the pars flaccida; the pars tensa are enlarged, convex, and prominent; their reference points are lost as is the light reflection; and there is an auditory loss among low as well as high tones.

e.2) Suppuration stage

The systemic symptoms and toxicity are at their high point; fever may exceed 40° C, there is a throbbing earache, tinnitus is accentuated, and the eardrum is convex, bulging, whitish, and lacks motility. Hyperemic vessels are congested in the periphery, and there may be small yellowish areas of necrosis over the ear drum. The malleus is in a vertical position but difficult to see, hearing loss is as pronounced in both upper and lower registers, and percussion may produce pain in the mastoid region. During this stage the rupture of the tympanic membrane is observed, usually in the pars tensa with the escape of purulent or serosanguineous material. Once the pus has drained the symptoms of toxicity decrease.

e.3) Stage of acute mastoiditis

Recurrent pain (usually nocturnal) and the copious discharge of purulent material associated with low fever suggest the presence of mastoiditis. Evidence of mastoiditis may not be clear if the patient had previously been treated with antibiotics or if the eardrum has broken. Generally, the profuse discharge from an ear over a period of two weeks after the rupture of an eardrum suggests mastoiditis. Percussion normally causes pain in the mastoid apophysis, the affected area appears enlarged and velvety to the touch, and the periosteum fails to move over the underlying bone. The perforation reveals enlarged mucous polypoid projections. If poor drainage traps the infection in the mastoid cells, systemic symptoms may recur. This stage is treated with high doses of antibiotics and simple mastoidectomy in order to drain the obstructed purulent material. The pain and other symptoms are relieved almost immediately and the purulent drainage subsides within a day or two. Usually a dry perforation is seen in the

anterosuperior quadrant of the tympanic membrane which is the last place to heal, three weeks to six months after the initial infection.

f) Specific otoscopic diagnosis

It is preferable to perform otoscopy using a diagnostic head with a closed light source and nipple for hook-up to the tube leading from the rubber bulb. The head is designed so that the speculum will adjust to the contour of the external auditory canal, creating a closed chamber made up of the head of the device, the bulb and tube running to the head nipple, the speculum, and the external auditory canal itself. As the bulb is gently squeezed and released, the degree of eardrum mobility in response to the change in pressure can be appreciated. This information is of critical importance in assessing the state of the middle ear. The other characteristics of the tympanic membrane can be observed in addition to its mobility. Pneumatic otoscopes are simple to use and provide timely reliable information on the presence of drainage and other middle ear pathologies (scarring and adhesion). Moreover, they do not pose any significant additional cost to explorations performed with nonpneumatic otoscopes. (See Figure 1.)

g) Etiology

Research recently performed in Mexico attempted to define the bacterial pathogens found in 50 children between the ages of 1 and 12 years who presented with AOM (32). Of the cultures taken, 62% were positive. The germs most commonly found are presented in Figure 2, with *Streptococcus pneumonia* and *Haemophilus influenzae* accounting for 20 of the 31 positive cultures (42% and 23%, respectively).

Figure 1. Otoscope with rubber bulb



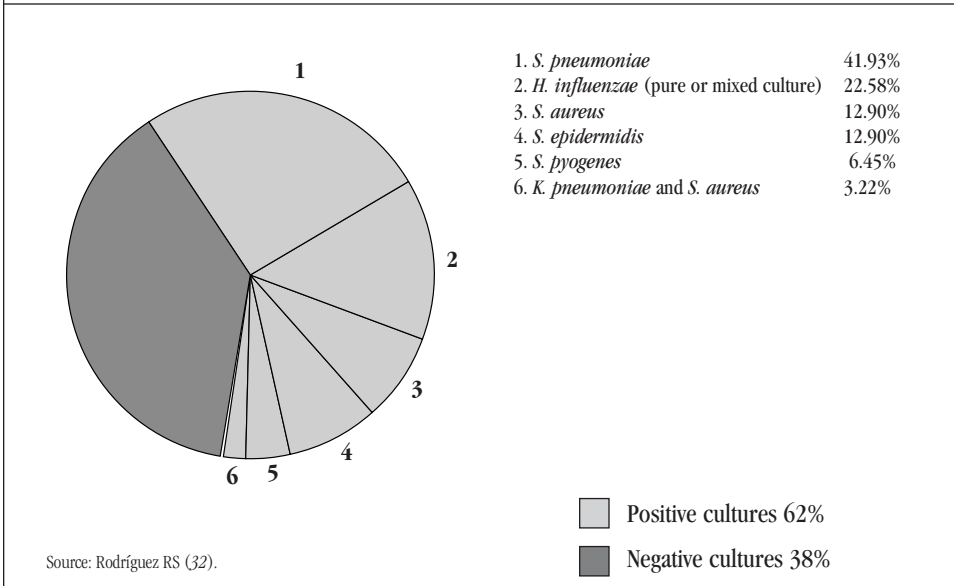
Figure 2. Microbiology of 31 positive cultures from 50 pediatric patients with acute otitis media

Table 3 shows the results of bacteriological studies of children with AOM in several countries in comparison with studies performed at the Children's Hospital in Mexico with regard to isolation of *Branhamella catarrhalis*, which accounts for 8% or more of the AOM cases in other studies. This germ is important, because in as many as 80% of the cases it can be a producer of β -lactamase (36), and therefore would be resistant to conventional drugs such as ampicillin or amoxicillin.

In newborn as in older children, the etiology of AOM is derived mainly from *S. pneumoniae* and *H. influenzae*, with the aggregate of enteric Gram-negative organisms and the occasional isolation of *S. aureus* and group B β -hemolytic streptococcus in 20% of the cases (37). Other authors have found this same group of organisms in this age group, but with *S. aureus* dominant and negative staphylococcus coagulase in higher proportions, 17% and 22%, respectively (38).

h) Treatment

Antibiotic treatment of AOM is based on the cumulative experience of bacteriological studies of tympanocentesis, which point to *S. pneumoniae* and *H. influenzae* as the dominant germs. Although one study indicated that antibiotic therapy did not greatly alter management of this disease (39), a careful reading of the data reveals that the group of patients that did not receive antibiotics had more complications (40). The author of a review of this issue concluded that in the case of AOM, antibiotic therapy hastened the relief of symptoms and eardrum scarring (41). Moreover, since the use of antibiotics to treat this condition has become so widespread, complications such as mastoiditis have virtually disappeared from communities that have access to medical services.

The antibiotics selected to treat AOM have been ampicillin and amoxicillin, because in comparison with cefaclor, erythromycin-sulfisoxazole, and TMP-SMK, they reach peak concentrations in the middle ear liquid higher than the minimum inhibitory concentration (MIC) of the three etiological germs most common as agents of otitis media: to wit, *S. pneumoniae*, penicillin-sensitive *H. influenzae*, and *S. pyogenes* (42). The dose of amoxicillin recommended for treating AOM is 40 mg/kg/day divided into three doses for 10 days. The advantage of ampicillin over amoxicillin is its lower cost, even though the latter is associated with a lower incidence of diarrhea and better tolerance (43).

Penicillin G and V taken orally reach concentrations in the middle ear that are high enough to inhibit most strains of penicillin-sensitive *S. pneumoniae*, *S. pyogenes*, and *S. aureus*, although these levels exceed the MIC for *H. influenzae* in only 50% of the cases. On the other hand, even though the use of oral penicillin, penicillin sodium, and penicillin procaine reaches the MIC required to inhibit Gram-positive bacteria, penicillin benzathine should not be used to treat AOM. Oral, sodium, and procaine penicillins should be used only with children over 6 years, among whom the frequency of otitis media from *H. influenzae* diminishes but does not disappear (44). If there is an allergy to penicillin, TMP-SMX may be used in doses of 10 mg/kg/day or SMX in doses of 50 mg/kg/day administered in two doses over a 10-day period. Another option is to use erythromycin-sulfisoxazole in doses of 50 mg/kg/day of erythromycin or four doses of 150 mg/kg/day of sulfisoxazole for 10 days.

The therapeutic success of these antibiotics against otitis media ranges from 80% to 90% (45). On the other hand, the appearance of β -lactamase-producing strains of *H. influenzae* and other germs with the same characteristics has decreased the success of conventional ampicillin and amoxicillin therapies (46, 47). The presence in the United States of β -lactamase-producing

Table 3. Comparisons from international studies using bacterial pathogens isolated from middle ear liquids

Bacteria	Number of children with pathogen in international studies	Average	Children's Hospital of Mexico
<i>S. pneumoniae</i>	26 - 53	33	41.93
<i>H. influenzae</i>	14 - 31	21	22.58
<i>S. pyogenes</i>	0.3 - 24	8	6.45
<i>S. aureus</i>	0 - 3	2	12.90
<i>B. catarrhalis</i>	0 - 8	3	—
<i>S. epidermidis</i>	0 - 12	—	12.90
Other organisms	0 - 2	1	3.22
Mixed cultures	0 - 2	2	9.67
Sterile cultures	25 - 40	34	38.00

Source: Twelve reports from the United States, Finland, and Sweden compared to the Children's Hospital in Mexico

strains of *H. influenzae* averages about 20% (48), and levels as high as 30% have been reported (49). Studies conducted in Mexico have found a 30% prevalence of isolated strains of β -lactamase-producing *H. influenzae* in cases of acute sinusitis alone or in association with otitis media (50). By the same token, the presence of *B. catarrhalis* (more recently denominated *Moraxella catarrhalis*) in 8% to 12% of the cases of AOM, but with β -lactamase production ascribed to over 75% of the strains, has had a significant impact on current AOM management.

With an appropriate antibiotic therapy, most children with AOM will undergo significant improvement within 48 to 72 hours of initiating treatment. If a positive response is not seen, and persistent or recurrent pain, fever, or both are observed during treatment, tympanocentesis should be conducted to determine the germ and its sensitivity in order to select the appropriate antimicrobial agent. If it is not possible to perform this procedure, treatment should resort to so-called second-line antibiotics that have demonstrated their efficacy against β -lactamase-producing strains of *H. influenzae* and *B. catarrhalis*. There are many such antibiotics whose usefulness has been demonstrated through studies. The first of these drugs, recommended for localities where β -lactamase-producing strains of *H. influenzae* are commonly found, is erythromycin-sulfisoxazole (41-45) or TMP-SMX (49), which nevertheless should not be administered when streptococcal pharyngitis is associated with otitis because of its ineffectiveness against *S. pyogenes*. On the other hand, other alternative therapies have been proposed, such as cefaclor (40 mg/kg/day for 10 days), which is effective (unlike cefadroxil) against all the β -lactamase-producing organisms, except some *B. catarrhalis* strains that produce that enzyme. The most serious secondary effects of cefaclor are the reactions similar to serum disease, with erythema multiforme, arthritis, or arthralgia (51). Another option is the amoxicillin-clavulanate compound, which has been shown to be effective in treating otitis media brought on by resistant bacteria (52). Secondary effects of this medication, when administered in doses of 40/mg/kg/day divided in three doses per day over 10 days (on the basis of the amoxicillin), presented in 33% of the cases treated; the most frequent being diarrhea (19%), followed by neutropenia (14%) and occasional urticarial eruptions (53).

h.1) Antihistamine and other decongestants

According to Wald, antihistamine decongestants are not effective either in preventing the development of middle ear drainage or in helping to resolve it once it has presented. If these drugs are used to treat an upper respiratory tract infection, it should be with the knowledge that although they may provide considerable relief of nasal symptoms (not of drainage), this relief is accompanied by even higher costs and toxicity (54).

Applying drops containing antibiotics directly to the external auditory canal of children with AOM and intact tympanic membrane is not recommended.

h.2) Chemoprophylaxis

Chemoprophylaxis is recommended for children who undergo three bouts of otitis media in a 6-month period or four bouts in 12 months, with at least one episode in

the last 6 months (49). Antibiotics recommended in different studies (55, 56) include a single 20 mg/kg dose of amoxicillin before bedtime. In the event of allergy to penicillin, 50 mg/kg of sulfisoxazole (Gantrisin®) may be used one time a day or 10 mg/kg doses of erythromycin ethyl succinate two times a day. Prophylaxis should last approximately 6 months or during the period of greatest incidence of respiratory infections (winter and spring). It is important to note that TMP-SMX is not recommended for AOM prophylaxis in children (57). The children that receive chemoprophylaxis should be examined at frequent intervals (every week or two weeks) to ensure that no asymptomatic middle ear drainage has presented.

III. ACUTE SINUSITIS

One author estimates that 0.9% of all acute respiratory infections (ARI) present sinusitis complications (58), but it may be more realistic to say the range of incidence is between 0.5% and 5.0% in light of how imprecisely the disease is often defined.

a) Anatomopathology

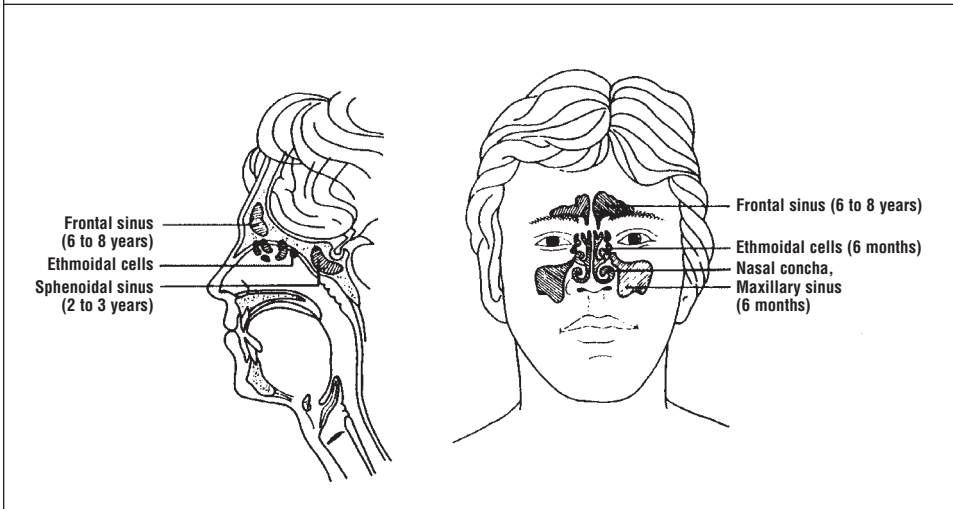
The maxillary and ethmoidal sinuses develop between the third and fifth month of gestation, with pneumatization occurring shortly after birth. The frontal and sphenoidal sinuses also develop during gestation, but remain in a primitive state for several years until achieving full pneumatization between 6 and 8 years of age. After age 10, the frontal sinuses gain greater clinical importance, because they are the most common site of infection and can become the focus of uncommon, but severe intracranial complications. In earlier years, the maxillary sinuses are most commonly affected; they begin to acquire clinical importance 18 to 24 months after birth (59). The sphenoidal sinuses, however, undergo appropriate pneumatization between ages 2 and 3 (Figure 3); except in cases of pansinusitis, they are rarely affected in children. Their location—adjacent to vital structures such as the carotid artery, cranial nerves, pituitary gland, optical nerve, and cavernous sinus—makes their infection extremely dangerous, and a delay in diagnosis and treatment may increase morbidity and lethality.

b) Predisposing factors and classification

The factors may be local or systemic; a number of them are listed in Table 4.

In addition to the above, the physiopathology of the sinuses includes three key elements in the functioning of the paranasal sinuses: 1) the sphenoidal ostium, 2) the function and integrity of the ciliary apparatus, and 3) the quality of secretions (60).

Ostium obstruction may result from edema or have a mechanical origin. In the first case, the main causes are viral infection of the upper respiratory tract and allergic rhinitis (61). Mechanical causes include deviated septum, nasal polyps, foreign bodies, choanal atresia, and tumors.

Figure 3. Schematic projection of the paranasal sinuses

In the classification of sinusitis by duration, acute sinusitis is generally accepted to last 30 days or less, whereas chronic sinusitis lasts longer.

c) Clinical presentation

The symptoms most commonly presented by adults and adolescents with sinusitis are facial pain, headache, and fever. In children the presentation is less specific. The first condition that should lead the physician to suspect sinusitis is the signs and symptoms of a persistent common cold. Nasal discharge and daytime cough continuing longer than 10 days without improvement are also manifestations of possible sinusitis. The nasal discharge may be of any type (thick or thin, clear, mucoid, or purulent), and the cough, which may be dry or wet, presents in daytime and is aggravated at night. When cough is the only residual symptom it is not usually specific and does not suggest sinus infection. Halitosis is more common in preschoolers and when accompanied by respiratory symptoms (in the absence of exudative pharyngitis, dental cavities, or a foreign nasal body), it is suggestive of sinus infection (62). Facial pain rarely presents except in rare cases of sphenoidal sinusitis (63) or in adults and adolescents.

The second presentation, which is less common, is when the child has a severe “cold” with high fever (above 39° C), purulent and copious nasal discharge, and there may be periorbital edema and facial pain. Periorbital edema may be situated in either the superior or inferior eyelid; it may be gradual and more obvious in the morning. Headache may present behind or above the eyes and occurs, albeit less frequently, in children over 5.

Physical examination of the patient with acute sinusitis may reveal mucopurulent discharge in the nose or retropharynx. Generally the lymph nodes in the neck do not enlarge or become painful, although the paranasal sinuses may exhibit pain when palpation or percussion are performed, and bad breath may be present. It is important to recall that sinusitis may co-present

Table 4. Predisposing local factors of sinusitis

- Viral infection of the upper respiratory tract
- Allergic rhinitis
- Hypertrophic adenoids
- Immobile ciliary syndrome
- Dental infections
- Deviated nasal wall
- Nasal polyps and tumors
- Choanal atresia
- Foreign bodies
- Facial trauma
- Swimming in contaminated water
- Cigarette smoking
- Indiscriminate use of decongestants

Source: Modified from references 60-62.

with acute otitis media. Table 5 lists the signs and symptoms one study recorded of 44 children with acute sinusitis admitted to the Federico Gómez Children's Hospital in Mexico.

d) Specific diagnostic methods

Transillumination, radiography, ultrasonography, and sinus puncture are useful diagnostic methods. Some authors caution that transillumination is useful only in the hands of an experienced examiner, and otherwise is of little value (65). In applying the procedure to the maxillary sinuses, the light source is placed mid-point over the inferior orbital border to evaluate the light that passes through the hard palate while the patient's mouth is kept open. Determination

Table 5. Signs and symptoms of 44 children suspected of sinusitis upon hospital admission and radiographs of abnormal maxillary sinuses

Signs and symptoms	Proportion
• Nasal discharge	44/44
• Bad breath	41/44
• Daytime or nighttime cough	36/44
• Fever (38.5° C or higher)	12/44
• Headache	8/44
• Facial pain or pain from palpation	5/44

Source: Rodríguez RS, De la Torre C, Sánchez C, et al. (64).

of a “diminished” or “opaque” transillumination is dependent on an extremely subjective and possibly erroneous interpretation that may bear little relation to the clinical pathology. This method is not recommended in children under 10 years of age due to the thickness of their soft tissues and bony structures.

Radiography has traditionally been used to determine the presence or absence of sinusitis. The radiographic projections typically used are Waters' for the maxillaries, Caldwell's for the ethmoidals, and Chamberlain-Towne's for the frontals.

The strongest radiographic indication of bacterial sinusitis is complete opacification or a water-air line (uncommon). The next most suggestive indication is mucosal thickening to ≥ 5 mm in adults and ≥ 4 mm in children, which strongly correlates with the presence of pus in the sinus and a positive culture (67). A normal radiograph suggests, but does not confirm, that the sinus is free of infection.

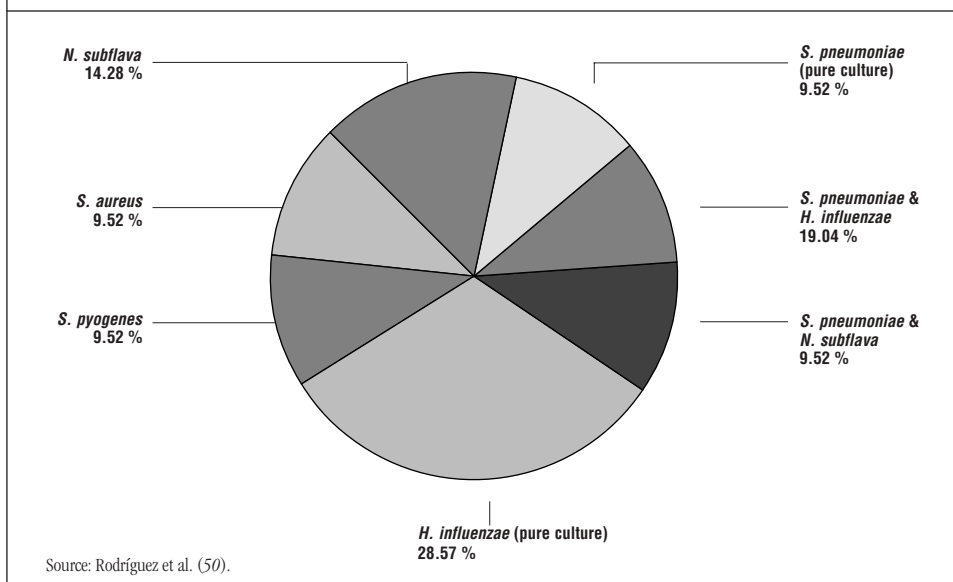
Some authors have found ultrasonography to be a useful diagnostic tool for acute sinusitis (68), although others reject this method on the basis of its poor sensitivity and specificity (69).

Sinus aspiration (antral puncture) is the only method that provides definitive diagnosis; the aspirate culture is the sine qua non for identifying the germ in bacterial sinusitis (70). Moreover, aspiration of the infected sinus may considerably relieve pain in patients with acute sinusitis, and the release of pressure allows better oxygenation and blood flow, thereby restoring the compromised defense mechanisms (71).

e) Microbiology of sinusitis

The predominant germs in acute sinusitis in children are essentially the same ones found in adults with sinusitis: *S. pneumoniae*, *B. catarrhalis* (*Moraxella*), and non-classifiable *H. influenzae* (72). As was seen in the section on otitis media, as many as 25% of the strains of *H. influenzae* and 75% of the strains of *B. catarrhalis* produce β -lactamase, which confers resistance to ampicillin (73). The most important germs in the microbiology of chronic sinusitis are the anaerobic bacterial species such as *Veillonella*, an anaerobic Gram-positive coccus, and fusobacteria (74). The most reliable bacteriology for both types of sinusitis is obtained through direct sinus punctures, because the cultures obtained from the nose, pharynx, and nasopharynx have absolutely no bearing on the microbiology obtained from inside the sinuses (67). The anaerobic germs that are most commonly isolated from chronic sinusitis include *S. viridans*, *H. influenzae*, and less often *S. aureus*.

Studies conducted in Mexico (64) have revealed a microbiology quite similar to that generally described in the literature, except that *S. pyogenes* and *S. aureus* were also found (each in 9.52% of the cases) in children with acute sinusitis, in addition to *S. pneumoniae* and *H. influenzae*. Fifty percent of the cultures taken through sinus puncture were positive, which was defined as $\geq 10,000$ colonies per ml (Figure 4). The negativity of many bacterial cultures can be explained by the implication of virus such as adenovirus and parainfluenza in the etiology of sinusitis (67).

Figure 4. Microbiology of 21 positive cultures from 44 pediatric patients with acute sinusitis ($\geq 10,000$ colonies/ml)

f) Treatment

Therapy for acute maxillary sinusitis in the pre-antibiotic era greatly stressed sinus aspiration and irrigation. The quick development and accessibility of many excellent effective antibiotics to treat acute sinusitis has displaced those methods as treatments of choice. The objectives of antibiotic therapy in sinusitis are: 1) to achieve a quick clinical cure; 2) to sterilize the sinus secretions; 3) to prevent orbital or intracranial suppurative complications; and 4) to prevent chronic sinusitis. The most frequently prescribed antibiotics are summarized in Table 6.

Table 6. Antibiotics used to treat sinusitis

Drug	Dosage
• Amoxicillin	• 40 mg/kg/day in 3 doses
• Erythromycin-sulfisoxazole	• 50 and 150 mg/kg/day in 4 doses
• Trimethoprim-sulfamethoxazole	• 8 and 40 mg/kg/day in 2 doses
• Cefaclor	• 40 mg/kg/day in 3 doses
• Amoxicillin-clavulanate potassium	• 40 mg/kg/day of amoxicillin in 3 doses

IV. CROUP AND OTHER INFECTIOUS OBSTRUCTIONS OF THE UPPER RESPIRATORY TRACT

This section examines the causes of the acute obstructions of the upper respiratory passages, 80% of which are infectious. Of these, 90% are caused by what is known as viral croup, 5% by epiglottitis, and the other 5% by infections from other anatomical areas within the upper respiratory mechanism. In all cases, however, correct diagnosis and immediate treatment are of critical importance, in many cases to save the life of the patient.

The description of these entities should lead to a precise localization of the obstruction as well as its etiology. Thus, distinctions need to be made between supraglottic infections (epiglottitis and supraglottitis) and subglottic infections (laryngotracheitis, laryngotracheobronchitis, and tracheitis), as well as between viral and bacterial infections in the etiology.

a) Definition of terms

Originally, croup referred to diphtheria, but after this disease had become successfully controlled through mass vaccinations, the term croup began to be applied to a variety of inflammatory conditions in the upper respiratory tract. Between 3% and 5% of all people will have croup at some point in their childhood, and it is the cause of 90% of the cases of stridor. Thus, today croup may refer to either of two conditions: 1) viral croup or laryngotracheitis, or 2) spasmodic croup.

Laryngotracheitis is a viral infection that normally begins with a respiratory prodrome and produces hoarseness, compression or barking cough, and, to a lesser extent, stridor during inspiration.

Spasmodic croup is a poorly understood condition that presents in children without fever or other prodrome (sometimes with just a slight respiratory infection) and awakens them in the middle of the night with compression cough and stridor.

Acute epiglottitis is a bacterial infection of the epiglottis and other supraglottic structures commonly caused by type B *H. influenzae*. It has a very poor prognosis and may quickly lead to asphyxiation if not treated immediately.

Bacterial tracheitis is an infection of the trachea, probably superimposed over viral laryngotracheitis, and occasions obstruction of the upper airways, high fever, and toxicity.

Laryngotracheobronchitis is an extension of laryngotracheitis toward the bronchia and bronchioles, including at times the lungs (aggregated pneumonia).

b) Supraglottic obstruction (epiglottitis)

“Few pediatric conditions more clearly reveal the benefits of optimum management and the risks of inappropriate action than obstruction of the upper respiratory tract.”

Holly W. Davis et al. (*Ped Clin N Am* 1981;28:859).

Epiglottitis is an infection of the supraglottic larynx that affects anatomical areas adjacent to the epiglottis, which is why the term *supraepiglottitis* is also appropriate (75) (Figure 5). It is associated with an unpredictable clinical course or with abrupt changes leading to complete obstruction of the upper respiratory tract that may cause the patient's death even when the condition is being appropriately handled (76). Children under 5 account for 80% of all cases; the remaining 20% is distributed among several pediatric ages. The average age in some studies was 2.6 years and the youngest patient was 7 months old (77).

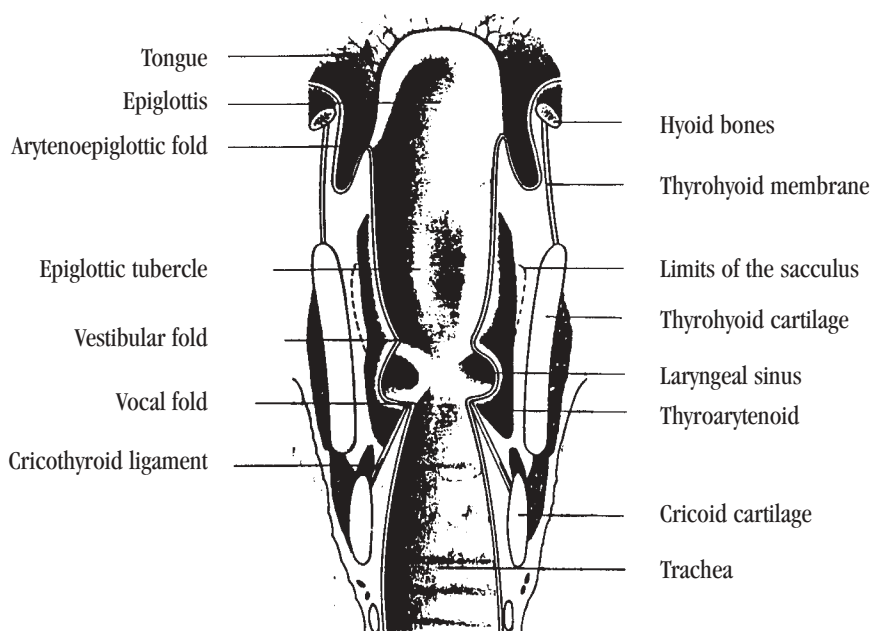
Blackstone (78) conducted a study of 71 cases of epiglottitis in which the average age was 3 years, four months, although 30% of the participants were under 2 years of age.

Lethality from epiglottitis has fallen continuously to the point that in some centers it has dropped to an average of 2% with the use of intubation and antibiotics, which are indicated in optimum diagnosis and treatment.

b.1) Clinical manifestations

The disease typically has a sudden onset with fever above 38° C, severe pharyngeal pain, and difficulty in swallowing. About 20% of the patients present with cough and, in some cases, vomiting. However, Mauro et al. (79) found that the presence of cough-

Figure 5. Coronal section through the larynx and the cranial extreme of the trachea (posterior aspect)



ing was not suggestive of epiglottitis and that the most suggestive symptoms and signs of the disease were an absence of spontaneous coughing and copious oral secretions (drooling) and agitation. Drooling in the absence of spontaneous coughing was the most specific indication of epiglottitis.

The absence of respiratory insufficiency at the onset hampers diagnosis. In contrast to patients affected by meningitis, these patients can tolerate rotation and flexion of the neck. A child who presents with fever, toxicity, and pharyngeal pain and whose pharynx appears normal may be in the early stage of epiglottitis. As edema progresses in the epiglottis, respiratory insufficiency develops, sometimes with extreme speed. The voice is soft or absent, and the child assumes a characteristic posture with the head inclined forward, the mouth open, jaw protruding, and tongue hanging out; this position holds the airway open to a maximum. The child prefers to remain seated, supporting himself with his or her two hands behind in a tripod-like position. The clinical course in these cases tends to deteriorate. Unless the obstruction to the airway is alleviated and appropriate antibiotics administered, the child will die of asphyxia and/or massive infection. Even though at this stage some children who suffer from a lack of air display a high degree of anxiety, others are astonishingly calm and attempt to maintain the characteristic posture to obtain maximum ventilation. The children should receive supplementary oxygen and humidified air, and should be attended by a team of CPR experts who can proceed to perform intubation or a tracheostomy. Once a patient begins to show exhaustion, cardiorespiratory stoppage may take place within minutes or hours.

Clinical manifestations of imminent respiratory insufficiency include severe retractions, anxiety turning to extreme disinterest and listlessness, hypertonicity, tachycardia (disproportionate to the magnitude of fever), diminished respiratory sound, and cyanosis. Table 7 presents a summary of the most frequent signs and symptoms of acute hyperglottitis, based on four articles.

b.2) Diagnosis

For a definitive diagnosis of epiglottitis, direct and immediate inspection of the epiglottis is required. If the pediatrician suspects this condition, the procedure should not be performed until an anesthetist or expert in endotracheal intubation becomes available.

Blanc (80) published the following protocol based on 212 pediatric patients with epiglottitis: a) If the clinical condition so permits (as it did in 90% of the author's cases), lateral and anteroposterior radiographs are taken of the neck, even in small nursing infants, to confirm or eliminate the initial clinical diagnosis. The anteroposterior radiograph facilitates recognition of the subglottic edema associated with epiglottitis (30% of the cases). b) If the clinical condition is alarming (10% of the cases), urgent confirmation is recommended requiring laryngoscopy and inhalation anesthesia.

The lateral neck radiograph should be reviewed immediately as the decision to intubate the patient or perform tracheostomy (increasingly rare) will depend on the find-

Table 7. Symptoms and signs of supraglottitis

Symptom or sign	Percentage
• High fever and respiratory insufficiency	100
• Pharyngeal pain	60
• Difficulty in swallowing and stridor*	50
• Loss of voice and compression cough	35
• Cyanosis	25
• Retractions	20

Source: Chery JD, Ann Otol Rhinol Laryngol (Suppl) 1981;90:19-21.
*If present, stridor usually is mild and soft and should not be used as an indicator of the degree of obstruction.

ings. The most significant indicators of the lateral radiography are: 1) open and protruding jaw; 2) dilated hypopharynx; 3) swollen and rounded epiglottis (thumb-shaped epiglottis) with inflammation of the arytenoepiglottic folds extending back and below; and 4) cervical curvature toward the back. The most important of these signs is the swollen appearance of the epiglottis, the structure of which is normal in cases of laryngotracheitis (croup).

Etiological identification of the bacteria is performed by taking a blood sample once the patient has been intubated.

b.3) Treatment

We cite the protocol for management of epiglottitis of Clark (81) of the Department of Otorhinolaryngology, University of Oklahoma, which can be considered the most logical and clearest of the methodologies reviewed for this publication. This protocol is summarized below:

- Management in the emergency room: The team that manages supraglottitis should consist of an anesthesiologist, a pediatrician, and an otorhinolaryngologist. While they proceed to examine the patient, the operating room should be prepared. Once the appropriate equipment is ready, the patient should be transferred, preferably borne upright (never reclining) in the arms of the mother or father, and accompanied by intubation experts. There is no need to perform blood tests, pharyngoscopy, or to take radiographs prior to the patient's transfer.
- Operating room management: Inhalation anesthesia is administered to the child while still in its mother's or father's lap. When the patient becomes dizzy, he or she is placed in a supine position and ventilation is provided with an anesthesia mask, with light positive pressure maintained on the anesthesia bag. Clark indi-

cates that the use of intravenous induction or muscle relaxants is not appropriate, because the maintenance of ventilation requires the patient's own continuous respiratory effort. The prescribed order for attempting to establish an artificial airway is first to intubate and next perform rigid bronchoscopy. The tracheotomy or cricothyrotomy is performed only when the intubation or bronchoscopy is unsuccessful. Multiple attempts to intubate a patient with epiglottitis can transform a partial laryngeal obstruction into a total one; thus, should the first two attempts at intubation or bronchoscopy fail, tracheostomy should be performed. The endotracheal tube should be 1 or 2 times below that which is defined as normal for the age of the patient.

Once a permeable airway is obtained, direct laryngoscopy is conducted to confirm the diagnosis and obtain cultures from the epiglottis. At this point hemocultures and the other necessary tests are taken (arterial gases, blood chemistry, blood biometry, and electrolytes, among others). In addition, the first dose of ampicillin, 400 mg/kg/day, is administered in combination with chloramphenicol, 100 mg/kg/day, until the sensitivity can be determined for type B *H. influenzae*, which is responsible for most cases found and includes several ampicillin-resistant strains. Once the sensitivity of the germ is known, adjustments in the type of antibiotics that are used can be made. Inhalation of racemic epinephrine is not useful in treating epiglottitis. Antibiotic coverage continues for a total of 10 to 14 days.

The airway should be secured for several days until inflammation and edema disappear. The reported duration of intubation in cases of supraglottitis ranges from 8 to 12 hours to as much as 60 hours. Before 48 hours have elapsed, the tube may be removed if fiber optic nasopharyngoscopy reveals that the signs of toxicity have been controlled and the redness and swelling in the epiglottis have diminished.

- Managing an emergency arising from the total obstruction of the airways: If the obstruction becomes total before the airway has been secured, the first consideration is ventilation with a rubber balloon. If an attempt to intubate the patient fails, the remaining marginal airway may have become totally obstructed. At that point a no. 14 needle can be inserted through the cricothyroid membrane to ventilate with oxygen using an appropriate connector. If ambú ventilation is not feasible and the child cannot be intubated, then emergency cricothyrotomy must be performed.

c) Subglottic obstruction

c.1) Spasmodic croup

This is a common form of croup caused by edema in the subglottic area of the airways. It has an abrupt, nocturnal onset without warning or fever (other than occasional coryza or mild rhinorrhea) and subsides during the day. Patients present a sudden cough, dyspnea, and inspiratory stridor. The attacks tend to recur but respond well to

environmental vaporization. One vaporization method is to leave open the hot water faucet of the bathroom with the door shut for a few minutes. Once the bathroom has filled with steam, the child is seated on the parent's lap so the humidified air may be inhaled for a few minutes. This will usually prove sufficient to overcome an attack. When such facilities are lacking, induction of vomiting or exposure to cold air is indicated.

This form of croup rarely causes a complete obstruction of the airways or symptoms serious enough to require intubation (82). Its pathogenesis is not known, nor is its relationship to atopia or prior viral infections (parainfluenza) that may act as sensitizers. Endoscopic studies in some patients have revealed non-inflammatory aqueous edema in the affected area. The attacks sometimes end spontaneously, just as they begin. If the child appears anxious, diphenhydramine (Benadryl®) may be administered in doses of 2 to 4 mg/kg/day divided in four portions. The patient will be helped by the antihistamine and sedative effects of this medication.

c.2) Viral croup (laryngotracheitis)

The peak age for contracting croup is between 12 and 24 months. The incidence may affect 3% to 5% of all children, but of these only 5% to 10% will have an obstruction sufficiently severe to warrant hospitalization.

The most common cause of laryngotracheitis is type I parainfluenza virus, which accounts for 40% of all cases. It is followed by type III parainfluenza virus, then type II, and by respiratory syncytial virus. Other viruses that may be causative agents include the adenovirus, types A and B influenza virus, and the microorganism *Mycoplasma pneumoniae* (83).

Table 8. Differential diagnosis for viral croup, spasmodic croup, and epiglottitis

Parameter	Viral croup	Spasmodic croup	Epiglottitis
• Peak age	12 to 24 months	12 to 24 months	4 years
• Onset	Gradual, 24 to 72 hours after the prodromic period	Abrupt, as with croup	Fast
• Posture	Supine	Supine	Seated
• Drooling	No	No	Yes
• Fever	Moderate	No	High
• Cough	Compression	Compression	Wet or absent
• Cause	Viral	Possible atopy	Bacterial

Laryngotracheitis commonly begins with an incipient 1- or 2-day period of infection in the upper respiratory tract. Fever, as high as 40.5°C, may be present for 1 to 4 days. In the first or second day, the child becomes hoarse and develops a metallic or compression cough. As the obstruction in the airways exacerbates, stridor and retractions occur. The cough and stridor usually worsen at night, with greater intensity on the second night (79). Although the severity of croup varies widely, most children suffer only mild cases. Severe croup is most common when atmospheric humidity is low due to the season or geographical location. Table 8 shows a way to gauge the severity of croup.

The best indicator of hypoxia is the number of breaths per minute (84), followed by restlessness, anxiety, or difficulty falling asleep. The clinical manifestations that indicate imminent respiratory collapse are severe retractions, restlessness that becomes indifference, hypertonicity, tachycardia disproportionate to the level of fever, diminished respiratory sound, and cyanosis.

c.3) Diagnosis

Besides considering the severity of croup, the physician must distinguish between viral croup (laryngotracheitis), spasmodic croup, and epiglottitis (Table 8). Endoscopy must be considered, whether there is a recurrent history of croup or prior endotracheal intubation, and whether the child persistently fails to respond to therapy. In nursing infants under 1 year of age, the differential diagnosis must consider the possibility of congenital subglottic stenosis.

With viral croup, lateral neck radiographs indicate a dilated hypopharynx with a normal epiglottis. The posteroanterior chest x-ray shows a narrowing of the glottis. As with epiglottitis, arterial gas findings are of little value, and puncturing to obtain them simply agitates the patient and exacerbates the obstruction (85).

c.4) Treatment

The basis of treatment for mild croup is humidification of the environment and the comfort and presence of the parents. Humidification alone will not successfully reduce the viscosity of the secretions; therefore, an ultrasound vaporizer is recommended to produce aerosol vapor. Use of steroids for these types of patients is of questionable value, as are hospital admissions.

For a child with moderate croup, hospitalization should be considered. The patient will require placement in a humidified, oxygenated air chamber, with nebulized racemic epinephrine added. This is a mixture of d- and l-epinephrine; the latter is the component more active and induces vasoconstriction and reduces the subglottic inflammation and edema. The indicated dosage is 0.5 ml of racemic epinephrine at 2.25% in 2 ml of saline solution, which is normally dispensed with a nebulizer, although intermittent positive pressure is a viable option.

Racemic epinephrine has only a short-term effect, so the patient should not be sent home until a few hours' observation demonstrate that severe symptoms will not recur.

With severe croup, a dose of 1 to 2 mg/kg/day of dexamethasone is administered for one 1 or 2 days at most (86), in combination with the air-chamber therapy indicated for cases of moderate croup. If desired results are not obtained, the child must not be allowed to reach exhaustion, which will precipitate collapse and death. Instead, respiratory insufficiency should be treated with endotracheal intubation.

In short, the symptoms that require introduction of an artificial airway are:

- Severe or persistent stridor that continues to worsen despite basic humidification treatment, and introduction of oxygen, racemic epinephrine, and steroids, with pCO₂ over 45 mm Hg; or
- Progressive fatigue.

The most significant and problematic complication of croup in intubated patients is subglottic stenosis. Other sequelae are higher incidence of asthma and hyperactivity of the airways, the reasons for which are not well understood (87).

In any event, every effort should be made to keep the period of intubation to a minimum. Children with croup who receive timely treatment have a good prognosis. They completely recuperate in almost all cases, and deaths are extremely rare.

V. REFERENCES

1. Jones DE. *Group B streptococcal colonization patterns in mothers and their infants*. J Clin Microbiol 1984;20:438-440.
2. Randolph ME, Redys JJ, Hibbard EW. *Streptococcal pharyngitis I. Correlation of cultures and clinical criteria*. Del Med J 1970;42:29-34.
3. Rodríguez RS, Méndez JE, Espinosa LE, et al. *Utilidad de la penicilina benzatínica combinada en el tratamiento de la faringoamigdalitis estreptocócica [Utility of combined penicillin benzathine in the treatment of streptococcal pharyngotonsillitis]*. Bol Med Hosp Infant Mex 1988;45:797-803.
4. Rodríguez RS. *Infecciones de vías respiratorias superiores en pediatría [Upper respiratory infections in pediatrics]*. Mexico City, Editorial Imprecalli. 1989.
5. Ranz LA, Di Carpio JM, Randall E. *Antistreptolysin O and antihyaluronidase titers in health and in various diseases*. Am J Med Sci 1952;224:194-200.
6. Dajani AS. *Current status of nonsuppurative complications of group A streptococci*. Pediatr Infect Dis J 1991;10:525-527.
7. Special Writing Group of the Committee on Rheumatic Fever, Endocarditis and Kawasaki Disease of the Council on Cardiovascular Disease in the Young of the American Heart Association. *Guidelines for the diagnosis of rheumatic fever; Jones Criteria, 1992 Update*. J Am Med Assoc 1992;268:2069-2073.

8. Ayoub E. *Immune response to group A streptococcal infections*. *Pediatr Infect Dis J* 1991;10:515-519.
9. Rodríguez RS. *Acute glomerulonephritis and scarlet fever caused by Streptococcus pyogenes type 2 (M-2/T-2)*. *J Infect Dis* 1974;130:315.
10. Finavuef XM, McCracken GH Jr., Jweighaft TC. *Serum penicillin concentrations after intramuscular administration of penicillin G benzathine in children*. *Pediatrics* 1982;69:452-454.
11. Gerber MA, Spadaccini LJ, Wright LL, et al. *Twice daily penicillin in the treatment of streptococcal pharyngitis*. *Am J Dis Child* 1985;139:1145-1150.
12. Breese BB, Disney EA, Talpley WB. *Penicillin in streptococcal infections: Total dose and frequency of administration*. *Am J Dis Child* 1965;110:125-130.
13. Porter AMW. *Drug defaulting in general practice*. *Br Med J* 1969;1:218-222.
14. Trickett PC, Dineen P, Mogabgab W. *Trimethoprim-sulfamethoxazole versus penicillin G in the treatment of group A β -hemolytic streptococcal pharyngitis and tonsillitis*. *J Infect Dis* 1973;128 (Suppl):S693-S695.
15. Gooch WM. *Alternatives to penicillin in the management of group A streptococcal pharyngitis*. *Ped Ann* 1992;21:810-815.
16. Gerber MA, Randolph MD, Chanatry J. *Once daily therapy for streptococcal pharyngitis with cefadroxil*. *J Pediatr* 1986;109:531-537.
17. Moffet HL, Siegel AC, Doyle HK. *Non-streptococcal pharyngitis*. *J Pediatr* 1968;73:51-60.
18. Ruuskanen O, Sarkkinen H, Meurman, O, et al. *Rapid diagnosis of adenoviral tonsillitis: A prospective clinical study*. *J Pediatr* 1984;104:725-728.
19. Pantell RH. *Pharyngitis: Diagnosis and management*. *Ped Rev* 1981;3:35-39.
20. Grose CH. *The many faces of infectious mononucleosis: The spectrum of Epstein-Barr virus infection in children*. *Ped Rev* 1985;7:33-44.
21. Reed BD, Huch W, Lutz LJ, et al. *Prevalence of Chlamydia trachomatis and Mycoplasma pneumoniae in children with and without pharyngitis*. *J Fam Pract* 1988;26:387-392.
22. Komaroff AL, Aronson MD, Pass TM, et al. *Serologic evidence of chlamydial and mycoplasmal pharyngitis in adults*. *Science* 1983;222:927-929.
23. Lim DJ. *Recent advances in otitis media with effusion. Report of research conference*. *Ann Otol Rhinol Laryngol* 1985;94:8-9.
24. Teele DW, Klein JO, Rosner BA. *Epidemiology of otitis media in children*. *Ann Otol Rhinol Laryngol* 1980;89 (Suppl 68):5-6.
25. Howie VM, Ploussard JH, Sloyer J. *The "otitis prone" condition*. *Am J Dis Child* 1975;129:676-678.
26. Nelson JD. *Prop the baby not the bottle*. *J Pediatr* 1971; 79:348-350.
27. Tainio W, Savilahti E, Salmenpera L, et al. *Risk factors for infantile recurrent otitis media: Atopy but not type of feeding*. *Pediatr Res* 1988;23:500-512.

28. Pukander J, Karma PK, Sipila M. *Occurrence and recurrence of acute otitis media among children*. Acta Otolaryngol (Stockholm) 1982;94:476-486.
29. Paradise JL, Bluestone CD, Felder H. *The universality of otitis media in 50 infants with cleft palate*. Pediatrics 1969;44:35-42.
30. Bluestone CD, Beery QC, Andrus WS. *Mechanics of the eustachian tube as it influences susceptibility to and persistence of middle ear effusions in children*. Ann Otol Rhinol Laryngol 1974;83 (Suppl 11):27-34.
31. Feigin RD, Kline MW, Spector G. *Otitis media*. In: Feigin RD, Cherry J, eds. Textbook of pediatric infectious diseases. Philadelphia, PA: W.B. Saunders; 1987:201-202.
32. Rodríguez RS, Sánchez C, De la Torre C. *La bacteriología y respuesta al tratamiento con eritromicina-sulfisoxazol en niños con otitis media aguda*. Bol Med Hosp Infant Mexico 1987;44:728-734.
33. Klein JO, Bluestone CD. *Acute otitis media, special series. Management of pediatric infectious diseases in office practice*. Pediatr Infect Dis 1982;1:66-73.
34. Wald ER. *Changing trends in the microbiology of otitis media with effusion*. Pediatr Infect Dis 1984;3:380-383.
35. Stull TL. *Bacteriology of acute otitis media: A new perspective*. J Pediatr 1992;120:81-84.
36. Nicoletti G, Speciale A, Caccamo F, Raso F. *Sulbactam/ampicillin in the treatment of otitis and sinusitis*. J Int Med Res 1991;19 (Suppl 1):29A-35A.
37. Shurin PA, Howiew VM, Pelton SI, et al. *Bacterial etiology of otitis media during the first 6 weeks of life*. J Pediatr 1978;92:893-896.
38. Karma PH, Pukander JS, Sipila MM, et al. *Middle ear fluid bacteriology of acute otitis media in neonates and very young infants*. Int J Pediatr Otorhinolaryngol 1987;14:141-150.
39. Van Bucken RL, Dunk JHM, Van Hol MA. *Therapy of acute otitis media: Myringotomy, antibiotics or neither*. Lancet 1981;ii:983-987.
40. Feldman, W. *Treatment of acute otitis media*. Lancet 1982; i:111.
41. McCracken GH. *Antimicrobial therapy for acute otitis media*. Pediatr Infect Dis 1984;3:383-386.
42. Krause PH, Owens NJ, Nightingale CH, et al. *Penetration of amoxicillin, cefaclor, erythromycin-sulfisoxazole and trimethoprim-sulfamethoxazole into the middle ear fluid of patients with chronic serious otitis media*. J Infect Dis 1982;145:815-821.
43. Feder HM Jr. *Comparative tolerability of ampicillin, amoxicillin and trimethoprim-sulfamethoxazole suspensions in children with otitis media*. Antimicrobial Agents Chemother 1982;21:426-427.
44. Schwartz RH, Rodríguez WJ, Khan WN. *Acute purulent otitis media in children older than 5 years: Incidence of Haemophilus as a causative organism*. J Am Med Assoc 1977;238:1032-1033.
45. Glebink S, Canafax DM, Kerpmpthorne J. *Antimicrobial treatment of acute otitis media*. J Pediatr 1991;119:495-500.
46. Syrioupoulou V, Scherfelele D. *Increasing incidence of ampicillin resistance in Haemophilus influenzae*. J Pediatr 1978;92:889-892.

47. Marchant CD, Carlin SA, Johnson CE, Shurin PA. *Measuring the comparative efficacy of antibacterial agents for acute otitis media: The Pollyanna phenomenon*. J Pediatr 1992;120:72-77.
48. Nelson JD. *Changing trends in the microbiology and management of acute otitis media and sinusitis*. Pediatr Infect Dis 1986;5:749-753.
49. Bluestone CD. *Management of otitis media in infants and children: Current role of old and new antimicrobial agents*. Pediatr Infect Dis 1988;7:S129-S136.
50. Rodríguez RS, De la Torre C, Sánchez C, et al. *Estudio comparativo de amoxicilina versus eritromicina-sulfisoxazol en el tratamiento de la sinusitis aguda en la infancia*. [Comparative study of amoxicillin versus erythromycin-sulfisoxazole in the treatment of acute infant sinusitis]. Presented at the 28th Interscience Conference on Antimicrobial Agents and Chemotherapy. Los Angeles, CA October 1988.
51. Levine LR. *Quantitative comparison of adverse reactions to cefaclor vs amoxicillin in a surveillance study*. Pediatr Infect Dis 1985;4:358-361.
52. Astruc J. *Efficacy and tolerance of a new formulation of amoxicillin, 100 mg, clavulanic acid 12.5 mg, in acute otitis in infants*. Ann Pediatr (Paris) 1992;39:142-148.
53. Kaleida P, Bluestone CD, Rockette HE, et al. *Amoxicillin-clavulanate potassium compared with cefaclor for acute otitis media in infants and children*. Pediatr Infect Dis J 1987;6:265-271.
54. Wald ER. *Antihistaminics and decongestants in otitis media*. Pediatr Infect Dis 1984;3:386-388.
55. Perrin JM, Charney E, MacWhinney JB Jr, et al. *Sulfisoxazole as chemoprophylaxis for recurrent otitis media. A double-blind crossover study in pediatric practice*. N Engl J Med 1974;291:644-667.
56. Maynardt JE, Fleshman JK, Tschopp CF. *Otitis media in Alaskan Eskimo children: Prospective evaluation of chemoprophylaxis*. J Am Med Assoc 1972;219:597-599.
57. *Physicians' Desk Reference*. Oradell, NJ: Medical Economics. 1988:826 and 1713.
58. Dingle JH, Badger GF, Jordan WS Jr. *Patterns of illness. Illness in the home*. Cleveland, OH: Western Reserve University, 1964:347.
59. Healy GB. *Acute sinusitis in childhood*. N Engl J Med 1981;304:779-781.
60. Wald E. *Epidemiology, pathophysiology and etiology of sinusitis*. Ped Infect Dis 1985;4(Suppl):S51-S53.
61. Shapiro G. Role of allergy in sinusitis. In: Bluestone CD, ed. *The diagnosis and management of sinusitis in children. Highlights of a round table*. Washington, DC. 1985;79.
62. Wald ER. *Sinusitis in children*. Pediatr Infect Dis J 1988;7 (Suppl):S150-S153.
63. Lew D, Southwick FS, Montgomery WW, et al. *Sphenoid sinusitis. A review of 30 cases*. N Engl J Med 1983;309:1149-1154.
64. Rodríguez RS, De la Torre C, Sánchez C, et al. *Bacteriology and treatment of acute maxillary sinusitis in children: Comparative study of erythromycin-sulfisoxazole and ampicillin*. Presented at the 28th Interscience Conference on Antimicrobial Agents and Chemotherapy. Los Angeles, CA, October 1988.

65. Stool SE. *Diagnosis and treatment of sinusitis*. Am Fam Physician 1985;32:101-107.
66. Wald ER. *Acute and chronic sinusitis: Diagnosis and management*. Ped Rev 1985;7:150-157.
67. Wald ER, Milmoie GJ, Bowen A, et al. *Acute maxillary sinusitis in children*. N Engl J Med 1981;304:749-754.
68. Rohr AS, Spector SL, Siegel SC, et al. *Correlation between A-mode ultrasound and radiography in diagnosis of maxillary sinusitis*. J Allergy Clin Immunol 1986;2:58-61.
69. Shapiro GG, Furukawa CT, Plerson WE, et al. *Blinded comparison of maxillary sinus radiography and ultrasound for diagnosis of sinusitis*. J Allergy Clin Immunol 1986;77:59-64.
70. Wald ER, Pang D, Milmoie J, et al. *Sinusitis and its complications in the pediatric patient*. Pediatr Clin N Am 1981;28:777-796.
71. Wald ER. *Sinusitis: Medical management, a pediatrician's perspective*. Pediatr Infect Dis 1985;4 (Suppl):S65-S66.
72. Wald ER, Reilly JS, Casselbrant M, et al. *Treatment of acute maxillary sinusitis in children: A comparative study of amoxicillin and cefaclor*. J Pediatr 1984;104:297-302.
73. Shurin PA, Marchant CD, Kim CH, et al. *Emergence of β -lactamase producing strains of *Brambanella catarrhalis* as important agents of acute otitis media*. Pediatr Infect Dis 1983;2:34-38.
74. Brook I. *Bacteriologic features of chronic sinusitis in children*. J Am Med Assoc 1981;246:967-970.
75. Shackelford GD, Siegel MG, McAlister WH. *Subglottic edema in acute epiglottitis in children*. Am J Roentg 1978; 131:603-605.
76. Lockhart GH, Battaglia JD. *Croup (laryngotracheal bronchitis) and epiglottitis*. Pediatr Ann 1977;6:262-269.
77. Baines DB, Wark H, Overton JH. *Acute epiglottitis in children*. Anaesth Intensive Care 1984;13:25-28.
78. Blackstock D. *Epiglottitis in young infants*. Anesthesiology 1988;68:822-825.
79. Mauro RD, Poole SR, Lockhart CH. *Differentiation of epiglottitis from laryngotracheitis in the child with stridor*. Am J Dis Child 1988;142:679-682.
80. Blanc VF, Duquenne P, Charest J. *Acute epiglottitis: An overview*. Acta Anesthesiol Belg 1985;36:140-141.
81. Clark K. *Acute supraglottitis - true pediatric emergency*. Indian J Pediatr 1988;55:721-731.
82. Davis HW, Gartner JC, Galvis AG, et al. *Acute upper airway obstruction. Croup and epiglottitis*. Ped Clin N Am 1981;28:859-880.
83. Denny FW, Murphy TF, Clyde WA, et al. *Croup: An 11 year study in a pediatric practice*. Pediatrics 1983;71:871-876.
84. Newth CSL, Levinson H, Bryan AC. *The respiratory status of children with croup*. J Pediatr 1972;81:1068-1070.

85. Battaglia JD. *Severe croup: The child with fever and upper airway obstruction*. Ped Rev 1986;7:227-233.
86. Koreh G., Frand M., Barzilay Z, et al. *Corticosteroid treatment of laryngotracheitis vs. spasmodic croup in children*. Am J Dis Child 1983;137:941-944.
87. Gurwitz D, Corey M, Levison H. *Pulmonary function and bronchial reactivity in children after croup*. Am Rev Respir Dis 1980;122:95-99.