

Chapter 68: Pharyngitis and Adenotonsillar Disease

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Waldeyer's ring of lymphoid tissue consists of the palatine (faucial) tonsils, lingual tonsils, pharyngeal bands, and adenoids. The palatine tonsil is a lymph node with prominent germinal centers that is separated from the lateral pharyngeal wall by a capsule of connective tissue. The tonsil lies in the tonsillar fossa, which has three muscles: the palatoglossus, which is the anterior pillar; the palatopharyngeus, which is the posterior pillar; and the superior constrictor, which forms the bed of the tonsil. Medially there are crypts lined with stratified squamous epithelium.

The arterial blood supply for the tonsil is from the descending and ascending palatine arteries and the lingual, tonsillar, and descending pharyngeal arteries. The venous blood drains through the peritonsillar plexus into the lingual veins and pharyngeal veins, which in turn drain into the internal jugular vein. The nerve supply is through the lesser palatine nerves to the pterygopalatine ganglion and through the glossopharyngeal nerve, which, through its tympanic branch, is the cause of referred ear pain in tonsillitis. The efferent lymph drainage is through the upper deep cervical lymph nodes, especially to the jugulodigastric group of lymph nodes behind the angle of the mandible. The adenoids (pharyngeal tonsil or Luschka's tonsil) have no crypts but folds lined by respiratory epithelium. The efferent lymph drainage is to the retropharyngeal and pharyngomaxillary space lymph nodes.

Pharyngeal Infections

Pharyngitis is prevalent during the cold weather season. Once maternal immunity no longer exists, at about age 6 months, children become susceptible to upper respiratory viral infections. A child, especially if he or she attends a day-care center, may experience eight or nine respiratory infections per year, with half of them associated with pharyngitis.

Viral infections

Viral infections of the oropharynx and nasopharynx are prevalent. Sprinkle and Veltri (1974b) proved that adenoviruses can cause tonsillitis. In fact, 10% of the patients had a fourfold increase in antibodies to adenovirus after tonsillitis. Enteroviruses cause the common cold, and coxsackieviruses cause herpangina, which is an acute febrile illness causing malaise and sore throat with petechial and small-vessel engorgement on the palate and anterior pillars. It is usually self-limited and resolves within 48 hours. Many other viruses can cause infection of the lymphoid tissue and upper respiratory tract: reoviruses, respiratory syncytial viruses, and myxoviruses, which cause croup. The treatment of viral infections is nonspecific and symptomatic. Antibiotics are helpful in cases of secondary bacterial infection. Polyvalent vaccines are helpful in prevention.

Infectious mononucleosis

Infectious mononucleosis resembles a severe attack of acute tonsillitis. Manifestations are similar: high fever; large, swollen, dirty gray membrane-covered tonsils (Fig. 68-1); malaise; sore throat; dysphagia; and odynophagia are present. These patients may have liver

damage, a skin rash resembling rubella, and petechiae on the palate. Splenomegaly may also occur. Infectious mononucleosis should be suspected in a young adult with tonsillitis that does not resolve despite antibiotic therapy. The cause of this condition is thought to be infection with the Epstein-Barr virus. Occasionally some cases have been attributed to infection with other viruses, such as cytomegalovirus. The method of transmission most probably is oral contact.

Specific diagnostic procedures include a differential blood count, which has 50% lymphocytosis with 10% atypical lymphocytes. Serologic studies include Monospot and serum heterophil antibody titers. The heterophil antibody titers are detected by the Bunnell-Davidson or ox-cell hemolysis tests. If the heterophil antibody agglutination test is negative, the disease may still be present. If, however, it is equal to or more than 1/56, it is diagnostic of the condition. Radiologically, infectious mononucleosis may be suggested by marked enlargement of all or any two of the following: adenoids, tonsils, and prevertebral cervical soft tissues (Sato and Dunbar, 1980). Treatment of this condition is symptomatic. Recovery may take weeks, and antibiotics are used to treat secondary bacterial infection. Ampicillin should be avoided because a rash may occur despite previous intake without similar reactions. Upper airway obstruction from severely enlarged tonsils can be life threatening and should be treated promptly with the insertion of a nasopharyngeal airway and short-term high-dose steroid therapy. If the obstruction is very severe and unrelieved by these measures, either a tonsillectomy and adenoidectomy or a tracheostomy should be performed.

Diphtheria

Diphtheria is suspected if a dirty gray membrane covers the tonsils, tonsillar pillars, soft palate, and uvula and if attempts at removal cause bleeding. A "bull-neck" appearance is secondary to cervical adenopathy. The constitutional and local symptoms of diphtheria initially are mild; however, the condition of the patient deteriorates quickly secondary to upper airway obstruction and cardiac toxicity. Identification of this disease is by fluorescent antibody studies. The presence of Klebs-Loeffler bacillus in the membrane is diagnostic by Gram stain and culture. Because diphtheria is an emergency condition, antitoxin should be given within the first 48 hours of onset to be effective. Airway obstruction should be managed by tracheotomy. Penicillin in high doses should be administered. People who are immunized by *Corynebacterium diphtheriae* can be carriers of this organism and may transmit disease to others (Zalma et al, 1970). Such people should be treated with penicillin, erythromycin, or tetracycline to eliminate the carrier state. If elimination is not achieved, a tonsillectomy is recommended.

Vincent's angina

Vincent's angina is secondary to *Spirochaeta denticolata* and Vincent's fusiform bacillus (*Borellia vincentii*), which can be cultured from the throat. This condition is slow in onset and has mild local and systemic symptoms. It usually appears in overcrowded conditions. Patients complain of malaise, headache, sore throat, and jugulodigastric lymph node enlargement. Temperature may be highly elevated. A membrane on the tonsil sloughs, showing an ulcer that rarely involves surrounding tissue and heals in 7 to 10 days. Treatment is with penicillin; if the patient is allergic to penicillin, the organisms should be cultured for sensitivities. Local treatment in the form of oral hygiene may be helpful. A closely related

condition, secondary to the same organism, is trench mouth; the only difference is that the ulcers in trench mouth include the gums and oral mucous membranes.

Tonsillitis

Sore throat is a term that includes any painful condition in the oropharynx; it has become associated with acute tonsillitis over the years. Group A beta-hemolytic streptococci cause only 15% to 20% of sore throats (Gellis, 1983). Acute tonsillitis is a disease of childhood with a peak incidence at around 5 to 6 years of age, but it can occur in children under 3 years of age (Schwartz et al, 1986) and in adults over 50 years. About half of tonsillitis cases are secondary to infection with hemolytic streptococci; staphylococci and pneumococci can also be found in cultures. Patients can be predisposed to tonsillitis by having low resistance, by having tonsils that are at a disadvantage secondary to previous recurrent tonsillitis, as part of a generalized pharyngitis, or secondary to a virus infection (usually adenovirus, which renders the tonsils susceptible to bacterial invasion). Overcrowding, poor nutrition, and inadequate ventilation help propagate epidemics of tonsillitis. Fatigue and exposure to cold may lower the body's resistance to infection.

Acute tonsillitis is manifested by a dry throat, thirst, malaise, fever, fullness in the throat, odynophagia, dysphagia, pain radiating to the ears, altered speech, headache, limb and back pain, swelling of regional lymph nodes, and shivering. Examination shows a dry tongue with swollen red tonsils and yellowish white spots, or, in severe cases, a membrane of purulent exudate may exist, along with jugulodigastric lymph node enlargement. Occasionally, afflicted children do not complain of a sore throat.

The diagnosis of acute follicular tonsillitis, although dependent mainly on clinical grounds, should also be documented by cultures for the presence of beta-hemolytic streptococci. The microbiologic cause of acute or recurrent tonsillitis is group A beta-hemolytic streptococcus, recovered from 40% of the cases (Peter and Smith, 1977). Cultures will detect more than 90% of infections secondary to group A beta-hemolytic streptococcus. Other organisms are alpha and gamma streptococci, diphtheroides, and (rarely) *Staphylococcus aureus* and *Haemophilus influenzae* (Brodsky et al, 1988a). Anaerobes have been recovered from the surface and the core of the tonsils, most belonging to the *Bacteroides melaninogenicus* (Brook et al, 1981).

The role of anaerobes may have been underestimated in acute and chronic pharyngitis, especially when these bacteria are penicillin resistant and produce beta-lactamase (Brook, 1985, 1987).

Treatment includes bed rest, good fluid intake, analgesics, antipyretic medications, and antibiotics. It is estimated that if no antibiotic is given, the disease usually lasts 1 week, whereas antibiotics shortens the episodes significantly and reduce the duration of sore throat, fever, headache, and the possibility of lymphadenopathy (Randolph et al, 1985). Another reason for the use of antibiotics is to prevent rheumatic fever and possibly glomerulonephritis. Because of the faster clinical improvement with antimicrobial treatment and availability of rapid diagnostic tools (MacKenzie et al, 1988) to detect streptococcal pharyngitis, it is wise to start treatment before culture results are available (Hedges and Lowe, 1986). Some physicians do not discontinue antimicrobials even if cultures are negative (Holmberg and

Faich, 1983). Penicillin for 10 days remains the recommended therapy (Gerber et al, 1987a) and is the antibiotic to be used in preventing rheumatic fever.

Some of the anaerobes are penicillinase producers; thus they protect themselves and beta-hemolytic streptococcus from the effect of penicillin G, resulting in a 10% to 18% treatment failure rate (Dillon, 1987). In such cases the patient still complains of a sore throat that never resolves completely; the ideal treatment in these cases is clindamycin (Randolph et al, 1970), lincomycin (Breese et al, 1969), or oxacillin (Simon and Sakai, 1963). In patients who are allergic to penicillin, erythromycin is the drug of choice. The effectiveness of erythromycin depends on adequate penetration into tonsillar tissue, which varies with the serum concentration and extent of tonsillar inflammation (Kaplan et al, 1974). Good results have been reported with 44 mg/kg body weight per day of erythromycin ethylsuccinate (Howie and Plousard, 1972).

Scarlet fever

Scarlet fever is secondary to acute streptococcal tonsillitis or pharyngitis with production of endotoxin by the bacteria. Manifestations include an erythematous rash, severe lymphadenopathy with a sore throat, vomiting, headache, fever, bright red tonsils and pharynx, tachycardia (which is more than expected secondary to fever), and sometimes a yellow membrane on the tonsils, pharynx, and nasopharynx. This membrane is more friable than the membrane seen with diphtheria. A strawberry tongue with a rash and enlarged papillae is a good diagnostic sign. Diagnosis is by culture and positive Dick test, which is an intradermal injection of dilute scarlet fever streptococcus toxin. Treatment of this condition is IV administration of penicillin G. Good response is expected. The ear complications of scarlet fever, necrotizing otitis media, can be disastrous, with complete loss of the tympanic membrane and the ossicles.

Lingual tonsillitis

Acute lingual tonsillitis (Elia, 1959; Jesberg, 1956) is usually unilateral, and pain is exacerbated on tongue depression. Tongue protrusion is restricted. Diagnosis is by examination with a laryngeal mirror or a fiberoptic rhinolaryngoscope. The presence of an acutely inflamed and tender tissue mass with white exudate at the base of the tongue is diagnostic of lingual tonsillitis. The differential diagnosis includes lingual thyroid or thyroglossal duct cyst, varicosities, dermoid cyst, and tumor. Treatment is by antibiotics, usually penicillin. Complications include lingual quinsy (Newman and Johnson, 1969), which needs to be drained. Epiglottitis, otitis, and laryngitis can ensue and can be dangerous if they cause respiratory obstruction. The lingual tonsils may hypertrophy and fill the inferior part of the tonsillar fossa, giving the impression of an incomplete tonsillectomy. If the hypertrophy is marked, it may cause apnea, with a plummy voice and the urge to clear the throat excessively. Soft tissue radiography is helpful in size assessment; for possible surgical interference (Willatt and Youngs, 1984), fiberoptic endoscopy provides an excellent view of the lingual tonsils. Treatment of enlarged lingual tonsils or recurrent acute lingual tonsillitis is lingual tonsillectomy (Joseph et al, 1984). Because of excessive intraoperative bleeding, use of laser or diathermy is advisable (Krespi et al, 1989).

Keratosis of tonsils (keratosis pharyngeus)

Keratosis of the tonsils is a condition in young adults that is secondary to metabolic disturbance, usually from general debilitation. These patients have excessive cornification of epithelial linings of the crypts of the tonsils, which show as wide horny projections from the surface of the tonsils and occasionally from other lymphoid tissue in the oropharynx. The presence of these projections is diagnostic. The patients sense a foreign body in the throat and thus initiate swallowing or coughing. Most of the time they are asymptomatic. There are no constitutional symptoms. Treatment is by removal, which may cause bleeding. The recurrence rate is very high. Improving the general health of the patient may be helpful.

Fungal infections

Candida albicans infection occurs in neonates, older people taking antibiotics, and immunocompromised patients. It is an infection of the oral cavity and oropharynx with occasional extension to the larynx and esophagus. White mucosal patches, dysphagia, odynophagia, and presence of *Candida* in pharyngeal scrapings on microscopic examination are diagnostic.

Treatment is with nystatin taken orally, 100,000 to 200,000 units every 6 hours in neonates and 500,000 units every 6 hours in adults. Fluconazole and ketoconazole are particularly effective in immunocompromised patients (Hay, 1990; Meunir et al, 1990).

Other causes of pharyngitis include oropharyngeal gonorrhoea (Hutt and Judson, 1986), which can be treated with aqueous procaine penicillin G or a simple oral regimen of two doses of ampicillin with probenecid 8 to 14 hours apart.

Chlamydia trachomatis and *Mycoplasma pneumoniae* are not important causes of acute pharyngitis in children (Gerber et al, 1987b).

Complications of Infections of Tonsils and Adenoids

Local complications

Peritonsillar abscess (quinsy)

Peritonsillar abscess usually occurs in patients with recurrent tonsillitis or in those with chronic tonsillitis who have been inadequately treated. The abscess rarely occurs in treated cases (Chamovitz et al, 1960). In 90% of the cases, spread of infection is from the superior pole of the tonsil, with formation of pus between the tonsillar bed and the capsule anteriosuperior to the anterior pillar. It is usually unilateral. Pain is severe, radiating to the ear a few days after the onset of tonsillitis. Drooling is caused by odynophagia and dysphagia. Thus dehydration is an accompanying condition along with cervical lymphadenopathy, trismus, and tilting of the neck to the same side. Systemic signs, such as fever and malaise, exist. There is a gross unilateral swelling of the palate and anterior pillar with displacement of the tonsil downward and medially and the uvula toward the opposite side (fig. 68-2). Cultures of the pus obtained usually show mixed bacteria, both aerobic and anaerobic (Sugita et al, 1982); some of the anaerobes are penicillin resistant.

Needle aspiration, surgical drainage, and quinsy tonsillectomy may be used in the management of this condition. Quinsy tonsillectomy is done after 12 hours of intravenous antibiotic coverage and is especially indicated in children because of the difficulty of needle aspiration or surgical drainage (Hold and Tinsley, 1981). Disadvantages of a quinsy tonsillectomy include the possibility of increased bleeding from the opposite end and the possibility of rupture of the abscess and pus aspiration during endotracheal intubation.

Needle aspiration or surgical drainage is performed with the patient under antibiotic coverage, which is usually intravenous penicillin. Drainage obtained through an incision in the anterior pillars is sent for Gram stain and culture. Tonsillectomy can be performed 6 to 8 weeks later, especially if there is an extensive history of tonsillitis.

Parapharyngeal abscess

A parapharyngeal abscess develops if infection or pus drains from the tonsils or a peritonsillar abscess through the superior constrictor muscle. An abscess forms between the superior constrictor muscle and the deep cervical fascia. This is a dangerous complication because of the presence of the great vessels. Patients have toxemia, pain in the throat and neck, and tender swelling of the neck and in the region of the angle of the mandible. On examination they may have tonsillitis. If this abscess extends anteriorly, Ludwig's angina may develop. If it extends posteriorly, it will infect the carotid sheath with serious complications. Trismus secondary to infection and edema of the pterygoid muscles exists. Diagnosis is best made by CT scan. Treatment of this condition includes intravenous antibiotics and external drainage of the mandible below the submaxillary gland.

Retropharyngeal abscess

Retropharyngeal abscess appears with dyspnea, dysphagia, and a large palpable fluctuant mass in the posterior wall of the pharynx. Lateral radiographs of the neck are helpful in diagnosis (Fig. 68-3) but can be misleading in younger children secondary to buckling of the retropharyngeal space on expiration. CT scan is diagnostic. Treatment is surgical because of impending airway obstruction. Utmost care must be taken to avoid aspiration of pus during endotracheal intubation.

Suppurative cervical adenitis

Suppurative cervical adenitis usually occurs in the jugulodigastric lymph node area. The causative organism is penicillin-resistant *Staphylococcus aureus* in most of the cases, and a penicillinase-resistant antibiotic should be used. Surgical drainage is indicated if an abscess forms.

Tonsillolith

A tonsillolith is a calculus of the tonsil (Fig. 68-4) that is secondary to deposition of calcium and magnesium carbonates and phosphates and debris in a tonsil crypt forming a hard mass around *Leptothrix buccalis*. It may cause discomfort, a foul odor in the mouth, and ulceration. Removal with follow-up examination for recurrence or a tonsillectomy may be performed.

Tonsil cyst

Tonsil cysts appear as single or multiple white or yellowish swellings on the tonsil and are secondary to entrapment of debris in tonsil crypts by fibrous tissue. Usually they are asymptomatic and more common in elderly people. For patients with local discomfort, incision and drainage are performed. If the problem is recurrent, a tonsillectomy may be performed.

Systemic complications

The systemic complications are mostly secondary to group A beta-hemolytic streptococci. Acute glomerulonephritis (found to occur in 10% to 15% after infection with certain serotypes) is secondary to the presence of a common antigen of the glomerulus with the streptococcus. Penicillin treatment may not decrease the attack rate, and a tonsillectomy may be necessary.

An association exists between acute streptococcal tonsillitis and ensuing rheumatic fever in most patients (3% in untreated patients) (Denny et al, 1950). A patient with rheumatic fever who does not comply with penicillin prophylaxis should have a tonsillectomy-adenoidectomy (Feinstein and Levitt, 1970), since patients who have undergone surgery have a lower infection rate with beta-hemolytic streptococcus (Matanoski et al, 1968). Awareness of the relationship between rheumatic fever and streptococcal pharyngitis has reduced the incidence to about 0.5 in 100,000 (Gordis, 1984). The report of Veasy et al (1987) shows that outbreaks of rheumatic fever do still occur.

Subacute bacterial endocarditis is secondary to tonsillar infection with streptococcus with systemic spread to a heart valvular lesion. This condition can be lethal if not treated adequately. Prophylactic penicillin preoperatively and postoperatively is indicated to prevent endocarditis.

Chronic adenoid and tonsillar disease

Local enlargement of the lymphoid tissue secondary to chronic infection can be a problem causing noisy mouth breathing, deglutition problems, and apnea. At birth the tonsils and adenoids are very small because of immunoglobulin transfer from the mother. Then they enlarge in size until the age of 4 or 5 years because of immune activity and subjection to infection (Brodsky et al, 1988b). Occasionally children are born with large tonsils and adenoids and present with serious obstruction. The assessment of tonsil size is easily performed, but assessment of the adenoid size must usually be inferred from a history of snoring and mouth breathing, palpation, and visualization by mirror or flexible nasopharyngoscope. Soft tissue lateral radiographs of the neck are very helpful (Fig. 68-5). The tonsils and adenoids decrease in size as puberty is reached and often atrophy in the adult (White and Dougherty, 1947). If a tonsillectomy-adenoidectomy has been performed a compensatory enlargement of the lingual tonsils and lateral pharyngeal bands may occur.

Chronic adenoid infection is expected between 3 and 6 years of age with concomitant hypertrophy. Patients complain of a mucopurulent anterior or posterior nasal discharge with mouth breathing, snoring, and occasionally nocturnal cough.

Speech problems, such as hyponasal speech (rhinolalia clausa) or, rarely, hypernasal speech (rhinolalia aperta) secondary to large tonsils (MacKenzie-Stepner et al, 1987) may develop. Orthodontic problems have been reported. Some children have the characteristic adenoid facies, which includes a pinched nose, short protruding upper lip, open mouth, and inverted lower lip. Children with recurrent adenoiditis, chronic adenoid infection, and enlargement secondary to infection or allergy should be managed by antibiotic treatment, antiallergic treatment, or both. If this management is not helpful and there is evidence of hypertrophy, surgery is indicated.

During acute tonsillitis minute abscesses form in the lymphoid follicles, which, if not adequately treated with antibiotics, will continue to exist within the fibrous tissue capsule only to cause another attack of tonsillitis that may recur within days or weeks. Inflammatory debris that has been trapped in the crypts of fibrous tissue leads to a subclinical infection and constant feeling of sore throat, with superimposed attacks of acute tonsillitis. This condition can be defined as chronic tonsillitis. Patients complain of halitosis, dysphagia, and bad taste in the mouth. Examination may reveal cryptic large tonsils with debris, voice muffling, and occasionally fibrotic tonsils because of recurrent infection and scarring. The presence of enlarged jugulodigastric lymph nodes may be associated with enlarged mesenteric lymph nodes, which may cause abdominal pain with every attack of tonsillitis. Treatment of chronic tonsillitis ranges from chronic antibiotic intake (in cases for which tonsillectomy is to be avoided or postponed) to tonsillectomy, which is very helpful when clearly indicated.

Tonsillectomy and Adenoidectomy

Indications

Severe upper airway obstruction

Severe obstruction of the upper airway can cause sleep apnea or even cor pulmonale (Menashe et al, 1965; Noonan, 1965). Noonan (1965) and Ainger (1968) both described hypoventilation with pulmonary hypertension and cor pulmonale secondary to partial upper airway obstruction by adenotonsillar hyperplasia (Figs. 68-6 to 68-11). Chronic upper airway obstruction (Ainger, 1968) results in hypoxia with carbon dioxide retention and secondary pulmonary edema with pulmonary hypertension and right-sided heart failure (Fig. 68-12), which is reversible in the early stages of the disease. Many reports have confirmed this syndrome, which manifests by snoring, obstructive apnea, pulmonary hypertension, daytime sleepiness, mental and growth retardation, and enuresis. It has been reported to cause death (Ainger, 1968; Guilleminault et al, 1975; Talbot and Robertson, 1973) and to be related to sudden infant death syndrome (Banks et al, 1975; Steinschneider, 1972). Both tonsillectomy and adenoidectomy should be performed.

Peritonsillar abscess

An estimated 10% of the surgery is secondary to peritonsillar abscess, which is a definite indication because of recurrence despite drainage.

Suspicion of malignancy

Tonsillar malignancy is usually secondary to lymphomas in children and epidermoid carcinomas in adults. A unilateral enlargement of the tonsil that is progressive and not related to infection should be investigated carefully, and an excisional biopsy should be performed.

Adenoid and tonsillar hypertrophy with malocclusion

The effect of adenoid hypertrophy and secondary mouth breathing on dentition and nasopharynx can be summarized as follows (Linder-Aronson, 1970, 1972):

1. The incidence of crossbite or tendency to crossbite is high.
2. The upper and lower incisors are retroclined secondary to lip tension.
3. The upper arch is narrow.
4. Small sagittal depth of the nasopharynx may be constitutional and not secondary to mouth breathing.

Relative indications

Recurrent tonsillitis is the cause of tonsillectomies-adenoidectomy in about 40% of the cases. The minimal criteria presented by the American Academy of Pediatrics and the American Medical Association were four or more episodes of tonsillitis with cervical adenitis within the preceding year. The indications that we follow are seven episodes in 1 year or five episodes per year for 2 years, or three episodes per year for 3 years that are associated with one or more of the following: temperature of 38.3°C (101°F), cervical lymph node enlargement, tonsillar exudate, and positive culture for beta-hemolytic streptococcus. The amount of time off school or work secondary to tonsillitis is an important consideration. Occasionally a distinct familial clustering of tonsillectomies-adenoidectomies is noted, which may be genetic, environmental, or attitudinal (Katznelson and Gross, 1980). In most of these cases the indication is usually recurrent tonsillitis.

A condition close to recurrent tonsillitis is chronic tonsillitis. It may be considered as a sore throat that is not as severe as recurrent tonsillitis but does not respond to antibiotics and is present for 6 months as manifested by enlarged cervical lymph nodes.

After penicillin treatment around one in five patients may continue to have positive throat cultures for *Streptococcus* and no serologic response. These patients are at a lower risk to develop rheumatic fever than patients with acute infection unless they already have developed rheumatic fever. Eradication of the carrier state may not be necessary (Dillon, 1987). Carriers can be a source of infection for immediate family members and close contacts, which may put these people at risk for developing recurrent tonsillitis. Carriers should be treated if they show clinical signs of infection, have a positive serologic response (Gerber et al, 1988), or cause infection in others. If antimicrobial treatment fails, surgical intervention should be considered. Recurrent tonsillitis in patients with poorly controlled diabetes, valvular heart problems, and ventriculoperitoneal shunts may be very serious and occasionally life

threatening, a tonsillectomy should be considered.

Another relative indication is in diphtheria carriers who do not respond to antibiotic treatment. Performing tonsillectomy because of rheumatic fever is not a well-clarified issue. We favor a tonsillectomy for patients with rheumatic heart disease, in whom antistreptococcal prophylaxis cannot be maintained with confidence.

An adenoidectomy occasionally can help in chronic maxillary sinusitis caused by severe chronic nasal obstruction. Concomitant with the adenoidectomy a single antral lavage is performed, and usually these patients respond completely. Deglutition problems secondary to tonsillar hypertrophy should be documented radiographically with a barium swallow study before surgery is performed.

Tuberculous cervical adenitis, which is adversely affected by superadded chronic infection (Ballantyne and Groves, 1979), is also a relative indication. Halitosis caused by an accumulation of debris in the tonsillar crypts can in some cases be a very annoying condition, for which a tonsillectomy becomes an indicated procedure.

Many studies address the issue of outcome from surgery. One of the earliest studies (Kaiser, 1930) found the surgery group to have fewer sore throats, colds, and cervical adenitis but more episodes of bronchitis and pneumonia.

McKee (1963a) excluded severe cases in his study. He found a reduction in sore throat and otitis media for 2 years. Adenoidectomies were found to be as effective as tonsillectomies-adenoidectomies in reducing the incidence of otitis media but less effective in reducing the incidence of cervical adenitis and sore throat. The incidence of sore throat in the control group also decreased over time.

Mawson et al (1967) had a significant reduction in sore throats in the first postoperative year but no change in incidence of otitis media. Also, sore throats improved with time in the control group. Roydhouse (1970) had results similar to those of the McKee study. Rynnel-Dagoo et al (1978) found no difference in nasal breathing 2 years after the operation from controls, as compared to a marked difference at 1 after adenoidectomy.

Paradise et al (1984) showed that the incidence of sore throat infections was markedly decreased in the first 2 years after surgery, with third-year differences favoring surgical groups over controls. Sore throat infections had no relation to age, sex, frequency of episodes according to history, tonsillar size, respiratory allergy, number of siblings, and socioeconomic status. Adenoidectomies do not eliminate the problem of recurrent otitis media, and it was uncertain if they reduce the rate, severity, or duration of recurrent episodes. Adenoidectomies for nasal obstruction, however, have shown excellent results.

The value of tonsillectomies-adenoidectomies in severe cases is beyond doubt. The benefit results from reduction of both pharyngeal microflora (Sprinkle and Veltri, 1974a; Veltri et al, 1972a) and obstructive symptoms, which can be severe enough to cause apnea, pulmonary hypertension, and possible death.

The relation of adenoidectomy to otitis media is not well defined. It was detrimental to children with marked eustachian tube reflux (Bluestone et al, 1972), and damage to the eustachian tube can cause eustachian tube stenosis with otitis media (McKee, 1963b). On the other hand, Lemon (1962) found that middle ear effusion recurred in 40% of children treated by a myringotomy alone, compared to 3% if adenoidectomy was performed along with the myringotomy. Maw (1983) showed that the beneficial effect of adenoidectomy on otitis media was highly significant at 1 year after surgery. There was no increased benefit from the addition of tonsillectomy. Gates et al (1987), after randomly assigning 578 children between 4 and 8 years into four treatment groups receiving therapy for chronic otitis media with effusion, concluded that adenoidectomy should be considered when surgical therapy is indicated for chronic otitis media with effusion. Adenoid size was not a factor in deciding to perform an adenoidectomy. Paradise et al (1990) found that adenoidectomy was helpful for treating otitis media over a period of 2 years after surgery in patients who underwent bilateral myringotomy and tube insertion for the second time.

The effects of adenoidectomy on dental occlusion are marked (Linder-Aronson, 1970, 1972). The resumption of nasal breathing after adenoidectomy is associated with beneficial growth of the upper dental arch and nasopharynx, compared to controls. Changes develop in the width of the upper arch and retroclination of the upper and lower incisors toward normal. After adenoidectomy, a change occurs from mouth to nose breathing. Thus the tongue position is raised and the lips are closed, which causes the dental changes. The other effect is on the sagittal depth of the nasopharynx - by decreasing the tension on the facial muscles, causing a decreased tension on the upper constrictor, with normal nasopharyngeal growth.

The incidence of sinusitis in cases of tonsillitis and adenoid hypertrophy has ranged from 22% (Mollison and Kendall, 1922) to 69% (Preston, 1955). The treatment of sinus infections by tonsillectomies-adenoidectomies alone helps in only approximately 37% of the cases (Paul, 1981). Merck (1974) showed that 25% of patients undergoing adenoidectomy or tonsillectomy-adenoidectomy had normal antral radiographs 6 weeks postoperatively, and 42% were normal without any other treatment.

The patient's general conditions improve postoperatively, especially children who have poor appetite with recurrent infections or hypertrophy and who miss school for many days each year. Pain should not be considered an argument against surgery since the pain from surgery is similar to the pain from tonsillitis, and the postoperative sore throat usually lasts for only 5 days.

Contraindications

The following conditions should be kept in mind whenever thoughts of a tonsillectomy or adenoidectomy are entertained.

The presence of submucous cleft palate manifested by the triad of bifid uvula (Fig. 68-13), midline furrow along the length of the soft palate, and notch into the posterior margin of the hard palate is an ominous sign for the development of velopharyngeal insufficiency after an adenoidectomy. A bifid uvula of any degree is a sign of an increased chance for the development of velopharyngeal insufficiency after surgery. If there is severe nasal obstruction

caused by adenoid obstruction of the posterior choanae then only superior half adenoidectomy is performed. The adenoids in the superior nasopharynx and posterior nasal choanae are removed, leaving the inferior part of the adenoids in the area where Passavant's ridge forms. This is best accomplished using the suction diathermy.

Tonsillectomies and adenoidectomies should be avoided in patients who have a hemoglobin count of less than 10 g/100 mL or a hematocrit level of less than 30. Inquiring about any bleeding problems during circumcision or teeth extraction is helpful. If any doubt exists, a complete hematologic workup is recommended.

Patients with asthma who are not taking medication may get an asthmatic attack after general anesthesia (Clein, 1952). Asthmatic patients should thus be monitored very carefully after surgery.

The decision to perform a tonsillectomy should be made without regard to the age of the patient, provided that surgery is carried out for appropriate indications and is performed in an appropriate institution. A complication rate of 10.5% in 190 patients under 3 years of age has been described, but most of the complications were not life threatening (Berkowitz and Zalzal, 1990).

The presence of an acute infection, be it an upper respiratory infection or tonsillitis, can increase operative bleeding markedly and spread the infection to the lower respiratory tract. Usually a 2- to 3-week period is recommended before the surgery is performed. This rule is not followed in cases of peritonsillar abscess because of the seriousness of the disease and the difficulty of drainage in children. During quinsy tonsillectomies the affected side with the abscess is usually dissected easily (autodissection), and the opposite side is the major source of the bleeding. However, with careful and meticulous dissection, bleeding can be kept to a minimum. The possibility of contacting poliomyelitis after a tonsillectomy is presently minimal in patients who have been vaccinated. However, a delay of 6 weeks after vaccination is advisable because in previous epidemics poliomyelitis increased after tonsillectomy (Aycock, 1942; Eley and Flake, 1938; Sabin, 1956).

Surgical technique

The preoperative management precludes the patient from taking solids by mouth up to 8 hours before surgery. The instruments for performing tonsillectomy and adenoidectomy are shown in Fig. 68-14. The patient is brought into the operating room where anesthesia induction and endotracheal intubation are performed, and the patient is placed in the Rose position (Fig. 68-15, A). A Crowe-Davis or similar mouth gag is inserted. The palate is inspected for presence of a submucous cleft (Fig. 68-15, B). A small nylon suture is placed through the uvula for retraction (Fig. 68-15, C), and the adenoids are inspected with a mirror (Fig. 68-15, D). Under direct mirror vision, an adenoid curette of appropriate size is placed against the posterior edge of the vomer to remove the adenoids and using the thumb as a fulcrum, the blade is firmly pushed along the vault of the nasopharynx (Fig. 68-15, E and F) and over the odontoid process of the axis. Care is taken not to injure the submucosal fascia or the superior pharyngeal constrictor muscle. In cases in which remnants of the adenoids appear in the posterior choanae, a small curette (Fig. 68-15, G) or suction cautery tool (Fig. 68-15, H) is used to clean that area. Moist sponges are packed in the adenoid bed. The right

tonsil is grabbed with a tenaculum (Fig. 68-15, I), and using a knife, scissors, or Bovie blade on coagulation, the surgeon makes an incision in the mucosa separating the tonsil from the anterior and posterior pillars (Fig. 68-15, J). Dissection is done bluntly with a Thompson dissector or Bovie blade in light coagulation (Fig. 68-15, K and L). Care is taken to stay in the capsule, so that a plane is developed between the capsule and the tonsillar bed. The superior pole is dissected first, and then dissection is carried inferiorly, and the tonsil is removed (Fig. 68-15, M). Care is taken not to injure the muscles of the base of the tongue. Blood is suctioned with a Yankauer's tonsil suction instrument. The tonsillar bed is packed with sponges, and a similar procedure is performed on the opposite tonsil.

The packs in the adenoid bed are removed, and a mirror is used to inspect for bleeding (Fig. 68-15, N and O), which is controlled by using suction cautery under vision with a mirror. The packs in the tonsillar bed are then removed, and bleeding is controlled by suction cautery.

After adequate hemostasis is achieved, the superior fossa is inspected with a mirror. Suturing of the lower pole is not recommended because of the proximity of the external maxillary and the lingual arteries. If a suture is inadvertently passed through them, sloughing and severe hemorrhage may occur.

The area is irrigated with saline, and blood clots are suctioned to prevent postoperative bleeding or aspiration of clots when the patient is awake. The specimens are sent for pathologic inspection. Intraoperative and early postoperative intravenous fluid therapy should be determined jointly by the anesthesiologist and surgeon and should be based on deficit replacement, maintenance fluids necessary until oral intake resumes, and replacement of blood loss (if any). In the chance of intrinsic cardiac or renal disease, balanced salt solutions are recommended, such as normal saline or lactated Ringers. In this manner, iatrogenic problems such as hyponatremia may be avoided. Postoperative orders include observation for bleeding, clear liquids only on the day of surgery, and a soft diet the following day. Fluids are given as tolerated. Acetaminophen is given for analgesia. Antibiotics are helpful in reducing postoperative complications (Handler et al, 1986).

The surgery is performed on an outpatient or inpatient basis as medically indicated by the surgeon responsible for the care and safety of the patient and not by the representative of the third-party payer, who is not responsible for the care and safety of the patient. The efficacy of tonsillectomy and adenoidectomy as an outpatient procedure in selected cases has been reported by Shott C et al (1987). Outpatient tonsillectomy and adenoidectomy is not recommended for patients with a history of obstructive apnea or for children under 3 years of age.

Complications

Paradise et al (1984) reported a 14% incidence of surgically related complications, all of which were readily managed or self-limiting. Complications can be secondary to the surgical procedure or anesthesia. The age-adjusted death rate from anesthesia is 1 in 14,000 (Avery and Harris, 1976). Anesthesia risks are traumatic intubation, cardiac arrhythmias (0.002%), and malignant hyperthermia. The incidence of serious surgical complications is reported to be around 15 cases per 1000 (Gibb, 1969). In England, Ranger (1968) reported

seven deaths per year, which is equivalent to a rate of 1/27.000 operations. In 20.000 tonsillectomies and adenoidectomies in a population of 100.000, Cummings (1954) found nine deaths: four from hemorrhage, three from cardiac arrest, and two from anesthesia. There were also seven lung abscesses and three foreign bodies. In 1968 the Commission of Professional and Hospital Activities found the mortality from adenoidectomy, tonsillectomy, and tonsillectomy-adenoidectomy was in the range of 1 in 16.207 procedures. Pratt (1970) reported on 6.175.729 cases and found 377 deaths, which is 1 in 16.381 cases. The causes were hemorrhage (0.002%), anesthetic reactions (0.002%), and cardiac arrest (0.002%); 2000 carotid ligations had to be performed, and 538 patients required more than 5 units of blood. Tate (1963) reported the incidence of death from tonsillectomy to be 1 in 10.000. Tolczynski (1969) reported Horner's syndrome, optic neuritis, pulmonary abscess, meningitis, brain abscess, paresis of glossopharyngeal and recurrent laryngeal nerves, and salivary fistulas from submaxillary gland to tonsillar fossa. Mediastinal emphysema has also been reported (Pratt et al, 1962); it was treated by tracheotomy.

Postoperative pain in children can generally be managed with acetaminophen, while in older children or adults stronger analgesics may be indicated.

Occasionally with calcification of the stylohyoid ligament and long styloid process, fibrosis in the tonsillar fossa, and pressure, pain may be chronic (Eagle syndrome). This pain is referred to the ear and can be diagnosed by pressing a finger in the tonsillar fossa. Radiography is usually helpful despite the occasional presence of an asymptomatic, elongated styloid process. It may occur after a tonsillectomy or, rarely, with the presence of a tonsil, in which a tonsillectomy has to be done to reach and cut the styloid process. Blood and foreign body aspiration is not unusual. Dislocated teeth can be dangerous if aspirated, and a radiograph should be made on the operating table whenever a dislocated tooth cannot be found. If a permanent tooth is dislocated, a dental consultation is sought and the tooth reinserted. Other aspirated foreign bodies include sponges and lymphoid tissue. Surgical trauma to the palate, uvula, pharyngeal wall, and eustachian tube has been reported. Psychologic trauma to the child should be prevented by kind and friendly preoperative care and adequate postoperative sedation and analgesics.

Airway obstruction

Postoperative airway obstruction can be very dangerous, as reported by Cummings (1954): two deaths were possibly secondary to the dislodging of a clot into the larynx. Every attempt should be made to clear blood clot from the field. Tongue edema, nasopharyngeal edema, palatal edema, and retropharyngeal hematoma can compromise the airway. Failure to spontaneously maintain adequate oxygen saturation postoperatively most often occurs in children with a preoperative history of obstructive apnea, and every care should be taken to monitor the patient adequately after surgery. This is the responsibility of the surgeon and often requires monitoring for 24 hours or longer postoperatively. This is especially important in children under 3 years of age.

Postoperative hemorrhage

The incidence of primary hemorrhage ranges between 0.5% and 2.2% (Handler et al, 1986), and secondary hemorrhage can be as high as 3% (Crysdale and Russel, 1986).

Postoperative hemorrhage can be secondary to coagulation defects or anatomically aberrant vessels. It can be immediate or delayed and from the tonsil or the adenoid bed. Every effort should be made preoperatively to detect any bleeding tendencies. If there is a suspicious family history, prothrombin time, partial thromboplastin time, platelet count, and bleeding time should be taken. In the absence of a history of bleeding disorder, such studies are not necessary. Persistent primary postoperative bleeding from the nasopharynx (Williams, 1967) might be secondary to remnants of adenoid tissue. Usually bleeding from that area is not severe and can be controlled with decongestant nose drops. With persistent bleeding, however, the patient should be taken to the operating room and the nasopharynx should be examined, the clots suctioned, the adenoid remnants curetted, and the bed cauterized. Posterior nasal packing is almost never indicated and can cause hypoxia and pulmonary hypertension. Slippage of the pack and obstruction of the glottis have also been reported (Alexander et al, 1965). Baron (1962) reported a case in which the bilateral vocal cord abductor and the right side of the tongue were paralyzed. The cause was edema of the parapharyngeal space with pressure on the vagus and hypoglossal nerves. An estimated 0.009% need transfusions; however, Avery and Harris (1976) estimate that 0.4% will need transfusion.

Pratt (1970) reported the incidence of carotid artery ligation to be 0.008%. Bleeding from the tonsillar beds should be controlled by suctioning any clots to prevent consumption coagulopathy, and the bed should be packed with a sponge soaked with a vasoconstrictor and an anesthetic. If this does not help and cauterization of the bed is impossible because of age or lack of cooperation from the patient, the patient should be taken to the operating room, where control of the bleeding is performed in the anesthetized patient with either electrocautery or sutures. In cases of generalized oozing the pillars may be sutured to each other (Emerson, 1952). The last resort is external carotid ligation.

The presence of aberrant vessels has been reported. McKenzie and Woolf (1959) reported an aberrant carotid artery that was injured in the left Rosenmüller's fossa by a punch forceps. Ligation of the common carotid artery was performed with transient hemiplegia. Three similar cases appear in the literature.

Secondary posttonsillectomy bleeding (Wright and Pray, 1951) is usually mild, consisting of a few drops of blood at about the seventh or eighth postoperative day, and is secondary to separation of the crust covering the tonsillar fossae. The patient should be informed about this condition, and in case bleeding is more than 10 to 15 mL, the physician should be contacted. Delayed bleeding is not as dangerous as primary bleeding (Walike and Chinn, 1979), but fatalities can occur, so the condition should not be considered lightly.

Immunologic risks

The tonsils serve as the initial trapping mechanism of a variety of antigens present in the environment, which are constantly applied to the surface of the tonsils (Brodsky et al, 1988b). In the tonsils 80% to 90% of the cells are lymphoid cells and 30% to 40% of the lymphocytes are T cells, whereas in the adenoids 25% to 30% of lymphocytes are T cells (Morag and Ogra, 1975). The immunoglobulins in the tonsil tissue are located mainly in the basal part of the crypt epithelium and the subepithelium (Ishikawa et al, 1972; Morag and Ogra, 1975). IgG, IgA, and IgM are higher than normal in patients with recurrent tonsillitis and return to normal after tonsillectomy-adenoidectomy (Lal et al, 1984; Veltri et al, 1972a).

The tonsils and adenoids are immunologically active both locally (manifested sometimes by the presence of large tonsils) and systematically (by shedding immunoglobulins into circulation).

The immunologic risks of removing the adenoids and the tonsils are not well known. Despite postoperative reduction in the overall serum immunoglobulins (Fiori-Ratti et al, 1983; Wingerd and Sponzilli, 1977), no adverse effect on health has been noted. A decrease in immune function related to bulbar poliomyelitis has been reported (Donovan and Soothill, 1973; Ogra, 1971).

Tonsillectomized patients may have a 2.9 times higher incidence of Hodgkin's disease (Davidson, 1973; Miller, 1966; Vianna et al, 1971), a greater susceptibility to leukemia (Cuneo, 1972), and a 1.7 times higher chance of contracting multiple sclerosis (Poskanzer, 1965). These disturbing studies have not been validated.

Infection. A local infection may occur, especially in concomitant sinus disease, in which pus bathes the raw area. Meningitis, brain abscesses, and even cavernous sinus thrombosis may occur. Otitis media is not an uncommon problem after an adenoidectomy. Atlantoaxial subluxation is thought to be of infective etiology (Gibb, 1969; Maslawala, 1977; Sipilia et al, 1981). Following adenoidectomy, postoperative hyperemia and infection results in decalcification of the vertebrae and laxity of the anterior transverse ligament between the atlas and the axis. The patient will have severe neck pain with stiffness and limitation of the head's range of motion. A low-grade fever, high erythrocyte sedimentation rate, and increase white blood count usually exist. Later in the course of the disease, radiographs become positive for anterior displacement of the atlas. Prompt antibiotic treatment with clindamycin and cloxacillin may save the patient from future collar immobilization, traction, or even possible spinal fusion. Children with Down's syndrome are prone to traumatic atlantoaxial subluxation. Preoperative cervical spine radiographs are indicated to rule out any existing pathologic condition. During the procedure neck extension should be avoided.

Hypernasality (rhinolalia aperta)

The incidence of velopharyngeal insufficiency after adenoidectomy-tonsillectomy is between 1 in 750 (Witzel et al, 1986) and 1 in 1459 cases (Gibb, 1958, 1969). Every caution should be taken preoperatively to prevent postoperative hypernasal speech. In cases of palate insufficiency secondary to shortening of the hard or soft palate, faulty development of the soft palate musculature, or cleft palate (of all degrees from cleft uvula to complete bony cleft), the adenoids may narrow the nasopharynx enough to permit complete closure of the velopharyngeal isthmus. Removal of the adenoids may lead to insufficient closure and air escape. In these cases adenoidectomy is contraindicated; in severe case of hypertrophy only superior adenoidectomy is performed. Froeschels (1951) states that velopharyngeal insufficiency exists in all patients to a mild degree preoperatively, and he recommends thorough examination of all patients by a speech therapist. Postoperative transient hypernasality may occur secondary to pain; the patient holds the throat muscles at rest during speech and swallowing and does not close the nasopharynx. This is called *habit palsy*. Occasionally this may be habit forming and persist long after the pain has resolved, in which case speech therapy is indicated.

Nasopharyngeal cicatricial stenosis

The incidence of nasopharyngeal cicatricial stenosis is approximately 3 in every 100,000 tonsillectomies-adenoidectomies (Figs. 68-16 and 68-17) (Imperatoni, 1944; Lehmann et al, 1968). The predisposing factors described by Lehmann include excessive mucosa destruction, surgery during pharyngitis or purulent sinusitis, revision adenoid surgery with removal of lateral pharyngeal bands, and keloid formation. Guggenheim (1963) reported 18 cases secondary to adenoidectomy that involved stripping lymphoid tissue from the torus, Rosenmüller's fossa, and the lateral pharynx. Figi (1947) found that in 37 cases of nasopharyngeal stenosis 22 cases were secondary to tonsillectomy-adenoidectomy. Treatment of this condition is usually by skin grafts or local mucosal flaps (Cotton, 1985).

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