Chapter 23 – Tonsillectomy

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Tonsillectomy is one of the very few surgical procedures that originated in ancient times and is still performed today. In the 1940s the incidence of tonsillectomy in the United States peaked at 2 million, most likely because it was performed not only for recurrent tonsillitis but also for a wide range of conditions, including poor feeding, failure to gain weight, overbite, “tongue thrust,” and enuresis. In the 1960s and 1970s there continued to be a trend to perform tonsillectomy, with 1 to 2 million tonsillectomies and adenoidectomies being performed annually in the United States.[1] Tonsillectomy is still one of the most commonly performed procedures today, with approximately 400,000 procedures performed annually.[2] The decrease in the number of operations is thought to be related to clinical trials that resulted in well-defined indications for tonsillectomy.[3]

Waldeyer's ring consists of the adenoids, lateral pharyngeal bands, palatine tonsils, and lingual tonsils. Although any or all of these condensations of lymphoid tissue can become hypertrophic and be susceptible to chronic infection, it is the palatine tonsils to which the term *tonsils* is applied. Because of the frequent coexistence of nasopharyngeal lymphoid hyperplasia (adenoid hypertrophy) and tonsillar hypertrophy, the adenoids are often removed at the time of tonsillectomy, particularly in prepubertal children.

The palatine tonsils are invaginated on the medial surface by crypts lined with squamous mucosa (Fig. 23-1). These crypts number from 6 to 20 and vary in depth and diameter. Epithelial debris collecting in these crypts and mixed with bacteria from the oral cavity cause chronic infection when the crypts become obstructed. These conditions predispose to the formation of tonsilloliths, which are often malodorous. The surrounding lymphoid tissue may hypertrophy in response to this infection and result in increased obstruction and persistence of inflammation. Purulent exudate may appear on the surface of the tonsils as it drains from the infected crypts (Fig. 23-2).

Although classic tonsillitis is due to group A β-hemolytic streptococci, tonsillitis can also be caused by various other agents such as coxsackievirus and Epstein-Barr virus (mononucleosis). Pillsbury and colleagues, using quantitative techniques, demonstrated that the *number* of bacteria found in the crypts of chronically infected tonsils exceeds by several hundred–fold the number of bacteria in the same quantity of uninfected tonsils. Their findings suggest that it is the state of chronic tissue sepsis rather than any specific organism that results in chronic tonsillitis.[4]

The tonsil is lined with a capsule on its deep surface and is separated by loose areolar tissue from the underlying superior constrictor muscle. Peritonsillar abscess, a condition thought to develop secondary to acute tonsillitis, is a collection of purulent exudate in this space. The walls of the abscess are made up of the tonsil capsule and the superior constrictor muscle. Penetration of the superior constrictor muscle by this abscess results in infection and, in some cases, abscess formation in the parapharyngeal space. The resultant anaerobic infection in the deep neck spaces can progress rapidly secondary to necrosis of surrounding tissue and can occasionally result in fatal vascular complications.

The blood supply to the palatine tonsils includes the ascending pharyngeal and ascending palatine arteries, which lie deep to the tonsillar fossa. Other vessels include the anterior tonsillar branches of the dorsal lingual artery, the inferior tonsillar branches of the facial artery, and the superior tonsillar branch of the descending palatine artery. Venous drainage occurs through the pericapsular plexus of veins into the lingual pharyngeal veins and then into the internal jugular. The internal carotid artery is located approximately 2.5 cm posterolateral to the tonsils. Efferent lymphatics pass to the superior deep jugular nodes. Alternative lymphatic pathways exit to the submandibular and superficial cervical lymph nodes. The efferent lymphatics that are located in the previously described areas are often the enlarged nodes that are seen clinically in patients with tonsillitis.

The tonsils are located in a fossa between folds of palatal musculature known as the anterior and posterior tonsillar pillars. These pillars are the palatoglossus and palatopharyngeal muscles, respectively. Preservation of these muscular regions and the overlying mucosa is critical to maintaining physiologic function of the palate postoperatively.

Tonsillitis and related problems are estimated to account for health care expenditures approaching half a billion dollars per year. There has been a decrease in the number of tonsillectomies performed over the past several years that is thought to be related to the use of antibiotics and to adherence to defined indications for tonsillectomy. In addition, economic issues that have led to occasional restrictions on reimbursement for the procedure have further decreased the number of tonsillectomies performed. Frequently, third-party payers require that certain specific indications be present before authorizing these procedures.

Attempts to perform outcome studies and develop rigid, formal indications for tonsillectomy have been difficult as a result of subjective aspects attributed to this procedure. Nevertheless, in Paradise's classic outcome study from the University of Pittsburgh published in 1984, some estimation of the value of the procedure can be appraised.[3] With the use of rigid entry criteria, 187 children were enrolled to determine the efficacy of the tonsillectomy procedure. Approximately half the children were randomized to either surgical management or observation; the other half were not randomized, but the course of therapy was chosen by the parents. A total of 95 children underwent tonsillectomy. For the first 2 years, a significant decrease in the number of throat infections occurred in the surgical group, although some children in the group under observation had very few infections. The author recognized the difficulty in predicting the likelihood of future infections and suggested that therapy should be individualized and not based on inflexible regulations. Nevertheless, these guidelines have been incorporated into the official recommendation of the American Academy of Otolaryngology–Head and Neck Surgery (AAO-HNS) (Table 23-1).[5]

In a recent study on indications for tonsillectomy and adenoidectomy, an evidence-based medicine approach was used. Absolute indications for tonsillectomy included adenotonsillar hyperplasia with obstructive sleep apnea, failure to thrive, abnormal dental and facial growth, suspicion of malignant disease, and hemorrhagic tonsillitis. Relative indications for tonsillectomy included tonsillar hyperplasia with upper airway obstruction, dysphagia, speech impairment, halitosis, recurrent or chronic pharyngotonsillitis, peritonsillar abscess, and streptococcal carriers.[6]

In an open, multicenter, randomized controlled trial in the Netherlands, 300 patients 2 to 8 years of age underwent adenotonsillectomy for mild symptoms of throat infections. Mild symptoms were defined as three or more infections per year; excluded, however, were children with seven or more infections, five within the past 2 years, or three within the past 3 years. In this study with a mean follow-up of 22 months, there were no major clinical benefits over watchful waiting in these patients with regard to the number of future episodes of fever, throat infection, or upper respiratory tract infection.[7]

Unlike the outcomes studies for tonsillectomy performed for mild recurrent infection, there are numerous studies that indicate improvement in quality of life for pediatric patients with upper airway obstruction or obstructive sleep apnea who undergo adenotonsillectomy. The patients with obstructive sleep apnea consistently showed improvement on quality-of-life questionnaires.[8]

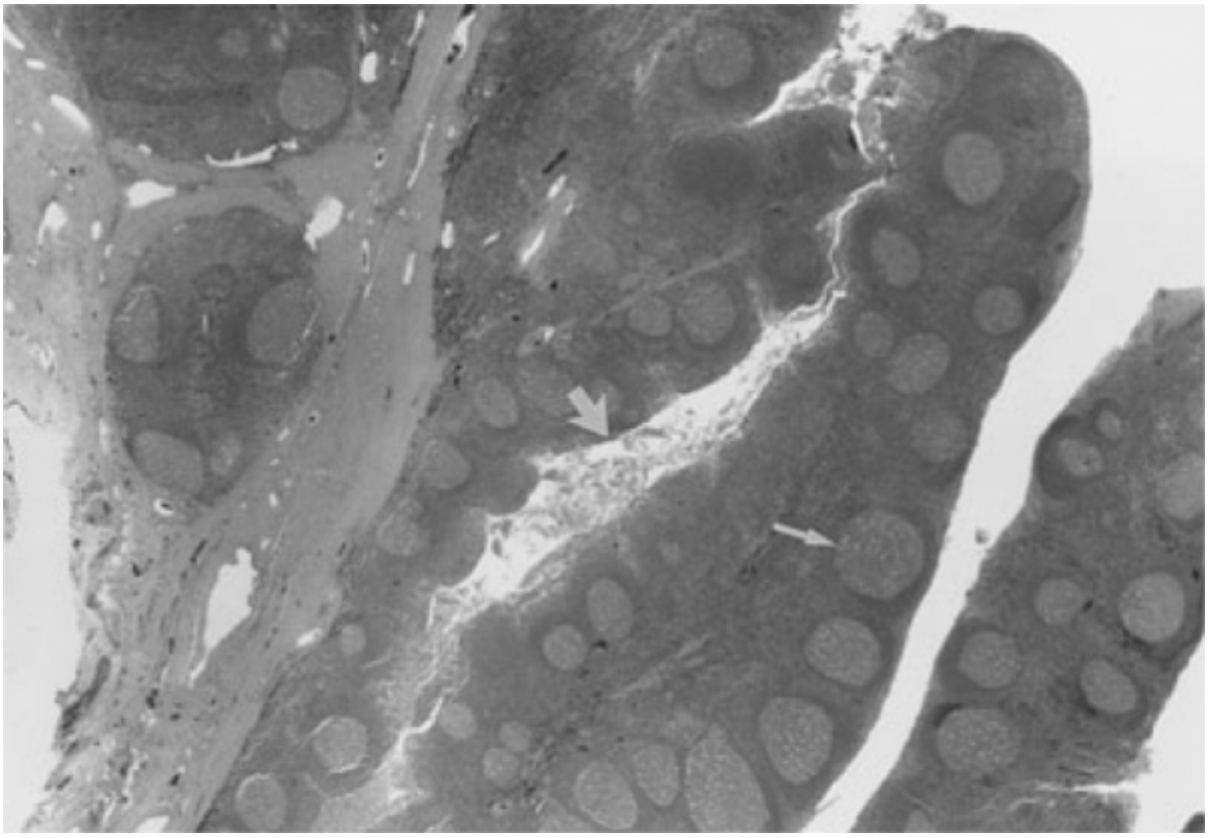

Figure 23-1 Microscopic view of a tonsil demonstrating debris-filled crypts *(large arrow)* and a lymphoid follicle *(small arrow)*.

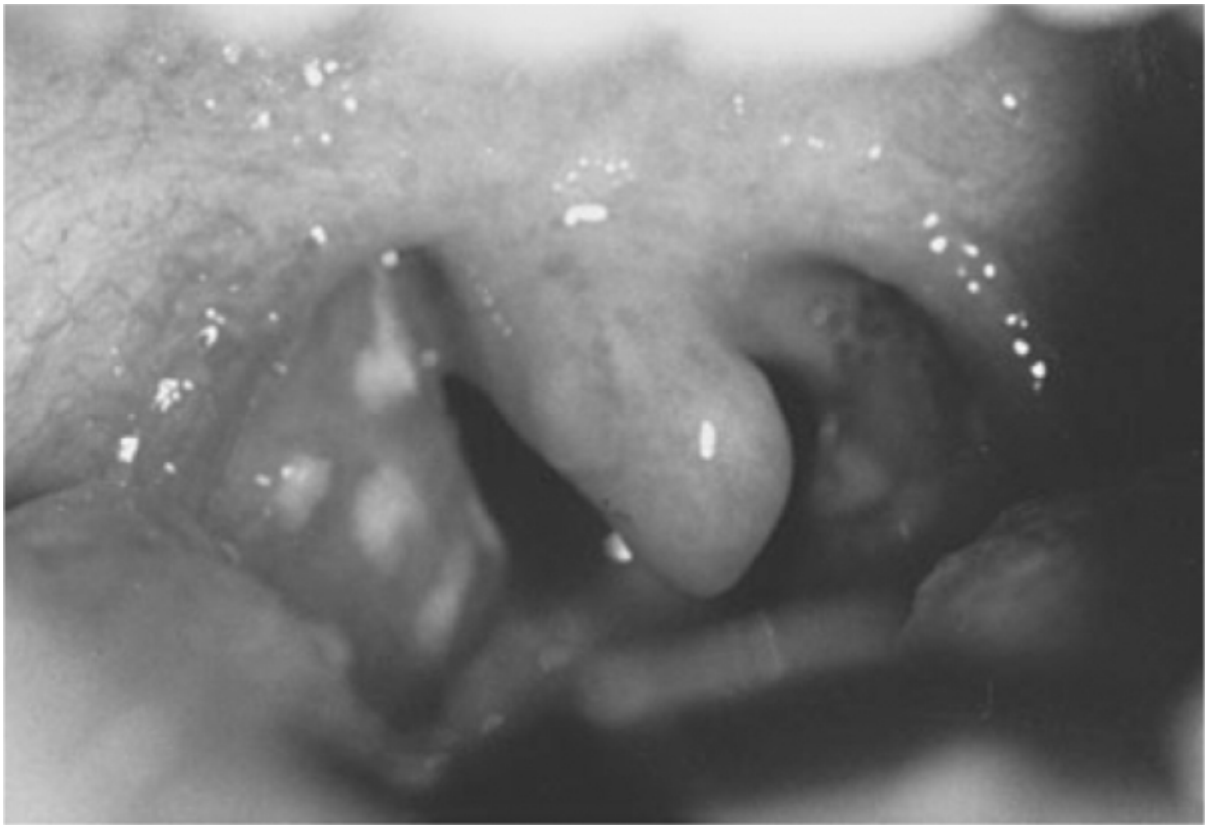

Figure 23-2 Acute follicular tonsillitis.

Table 23-1 -- CLINICAL INDICATORS FOR TONSILLECTOMY

	A	B	C	D	E	F	G	H
History (one required)	[*]Patient with three or more infections of the tonsils and/or adenoids per year despite adequate medical therapy	[†]Hypertrophy causing dental malocclusion or adversely affecting orofacial growth documented by an orthodontist	Hypertrophy causing upper airway obstruction, severe dysphagia, sleep disorders, or cardiopulmonary complications	Peritonsillar abscess unresponsive to medical management and drainage documented by a surgeon, unless surgery is performed during the acute stage	Persistent foul taste or breath as a result of chronic tonsillitis not responsive to medical therapy	Chronic or recurrent tonsillitis associated with the streptococcal carrier state and not responding to β-lactamase-resistant antibiotics	Unilateral tonsillar hypertrophy presumed neoplastic	Recurrent suppurative or otitis media with effusion (adenoidectomy alone). Addition of tonsillectomy requires one of the indications listed (A-G)

From Clinical Indicators Compendium. Alexandria, VA, American Academy of Otolaryngology-Head and Neck Surgery, 1995.

* For infectious conditions it is recommended that there be information regarding dates of the last two infections, description of fever, severity of discomfort, information about throat cultures, use of antibiotics, and history of otitis media management.

† For hypertrophy or noninfectious conditions it is recommended that the history include information regarding growth and weight gain, any medical conditions necessitating removal of the tonsils and adenoids, and polysomnography (optional), including the hourly number of apnea or hypopnea episodes.

PATIENT SELECTION

Indications for the procedure cover a wide range of illnesses and conditions; some of them are listed in Table 23-2. The most frequent indication is recurrent tonsillitis; hence, the most specific guidelines have been developed for this indication (Table 23-1).[5] These guidelines suggest that a patient who experiences four or more episodes of acute tonsillitis per year would benefit from performance of the procedure. We believe that these guidelines,

though helpful, should not be rigid. The decision to perform tonsillectomy may be based on the amount of time that the patient is “nonproductive.” Nonproductivity may be assessed by discussing the severity of illness and the impact of the illness on the patient and family. The decision to perform tonsillectomy may also be based on the impact on the patient's chronic medical conditions and exacerbation of these conditions secondary to tonsillitis. For instance, few very severe infections may represent more of an indication for surgical intervention than frequent mild infections. Often, an adult patient has experienced recurrent tonsillitis for some years, usually has excessive time away from work or school, and has reached the point of frustration and a desire to “fix the problem.” In children, a watch-and-wait attitude is often warranted if the otolaryngologist is the first physician consulted by the parents to evaluate the child. However, if the patient has been seen by a pediatrician who has referred the patient, the history usually suggests that the patient has failed to respond to conservative treatment and would benefit from tonsillectomy.

Table 23-2 -- INDICATIONS FOR TONSILLECTOMY

Recurrent tonsillitis
Airway obstruction
Sleep apnea
Acute mononucleosis
Peritonsillar abscess
Biopsy
Spontaneous tonsillar hemorrhage

The decision to proceed with adenoidectomy at the same time is made by taking into consideration the symptoms and age of the patient. Younger patients will frequently have physiologically large adenoids, tonsillar hypertrophy, and chronic tonsillitis and will have symptoms of mouth breathing and chronic rhinorrhea. These patients would benefit from adenoidectomy. Adults and adolescents are less likely to have adenoid hypertrophy because adenoid tissue usually regresses by adolescence and does not typically require adenoidectomy. However, visualization of the nasopharynx should be performed during the procedure if there is concern about hypertrophic adenoid tissue.

Patients who have episodes of tonsillitis and known coagulopathies themselves or have family members with such a history represent a very significant problem and one that should be approached with great caution. Although such patients may undergo tonsillectomy uneventfully, there is a possibility of significant and prolonged bleeding at any point from the time of the procedure through healing of the fossae some weeks later. Reluctance should be the rule in scheduling these patients for tonsillectomy, and active involvement of a consultant hematologist is necessary. There have been studies indicating that preoperative assessment based on a history of bleeding cannot predict abnormal laboratory data, to therefore performance of routine blood tests is not cost-effective.[9] Preoperative autogenous blood banking and the use of designated donors may assist in ensuring a satisfactory outcome. Patients with bleeding dyscrasias who come from specific religious groups that prohibit the use of blood or blood products should not undergo tonsillectomy in the community hospital setting but rather should be referred to academic institutions prepared to handle this type of medical-ethical dilemma.

SURGICAL TECHNIQUE

Types of Procedures

Various surgical techniques are available for the performance of tonsillectomy, as listed in Table 23-3. We favor electrodissection because this technique results in minimal blood loss, as well as decreased operating time without healing problems. All of the techniques described use the principle of careful dissection in the subcapsular plane and meticulous hemostasis at the conclusion of the procedure. New techniques as listed in the Table 23-3 usually meet with initial enthusiasm by ear, nose, and throat surgeons. This enthusiasm often dissipates, however, when these procedures and their complications are compared with those of traditional techniques such as electrodissection and cold knife techniques.

Table 23-3 -- SURGICAL TECHNIQUES FOR TONSILLECTOMY

Guillotine
Tonsillotome
Dissection with a snare
Electrodissection
Laser dissection
Coblation
Harmonic scalpel dissection

Radiofrequency dissection
Power tool dissection

Coblation

Electrosurgery, a technique in which an electrical current is applied, has been used for cutting, ablation, coagulation, and hemostasis during tonsillectomy. In coblation technology the mechanism of action differs in that tissue ablation occurs as a result of dissociation of organic molecules rather than the conventional heat-based processes described. This altered mechanism of action is thought to minimize thermal damage to adjacent tissue structures.

The coblation technique, unlike previous radiofrequency, uses bipolar current to create a plasma field, which can then split tissue. Creation of the field occurs at temperatures of only 60° C to 70° C, which is less than those produced with conventional radiofrequency and electrocautery. This decreased temperature requirement for electrocautery is thought to diminish surrounding tissue damage. When used correctly, the plasma field slices the peritonsillar connective tissue while a coexisting low-power current coagulates vessels. Larger vessels are controlled with the coagulation-only pedal without creation of the plasma ion field.

The literature indicates an improved quality of life and decreased pain associated with coblation. In a study of 150 patients who underwent coblation tonsillectomy, coblation subtotal tonsillectomy, or cold dissection tonsillectomy, the end points of pain, return to regular diet and normal activity, and the use of pain medication were studied. The coblation procedures were found to be safe with decreased postoperative pain and earlier resumption of normal diet and activity levels. Other studies have also demonstrated significantly decreased pain levels with fewer patient contacts with physicians regarding complications in the coblation group.[10] There is also less need for prescription narcotics in the coblation group than in the electrocautery patients, and parents rate the postoperative experience as better than expected. This led to the conclusion that children who undergo tonsillectomy via coblation experience a better-quality postoperative course than do those who undergo conventional electrocautery.

Bleeding rates for tonsillectomy are difficult to compare because they are not always reported. This is also the case for bleeding rates reported for coblation tonsillectomy. Numerous articles report a bleeding rate after coblation tonsillectomy that is less than the national rates of approximately 1% to 7 %.[11]

Other studies, however, report a higher rate, one citing a 24% rate of hemorrhage.[12] Coblation may offer an alternative, safe technique that affords decreased or similar postoperative hemorrhage rates, as well as decreased pain, and therefore more rapid return to function for patients in the future. There does appear to be less postoperative pain in patients who have undergone coblation surgery; however, operative time is generally increased.

The author has used the coblation technique and finds it easy to incorporate into daily practice. Bleeding rates do not appear to differ between conventional electrosurgical tonsillectomy and coblation; however, bleeding severity may be more pronounced.

Radiofrequency Ablation

The radiofrequency technique, which is somewhat similar to the coblation technique, has also been listed in the literature as a method for performing tonsillectomy. There is also mention of using the radiofrequency technique to perform partial tonsillar ablation or tonsil reduction in children with tonsil hypertrophy. The temperature-controlled radiofrequency technique operates by heating the target tissue through an electrode placed submucosally. The radiofrequency generator regulates energy flow to form a precise lesion. This lesion is then gradually reabsorbed by the body, thus shrinking tissue volume while leaving the overlying mucous membrane intact. An electrode is available for tonsil reduction. There is an apparent decrease in postoperative morbidity when compared with the traditional tonsillectomy technique in patients undergoing tonsillotomy or ablation rather than complete removal.[13,14]

Harmonic Scalpel

The harmonic scalpel has also been used for tonsillectomy. In this procedure, ultrasonic technology is used to cut and coagulate tissue at temperatures lower than those associated with electrocautery and lasers. This scalpel has been used for other techniques in otolaryngology and other fields of surgery. In contrast to electrocautery or laser dissection, cutting and coagulation occur at temperatures typically three to four times lower than the temperatures that occur in the traditional electrocautery technique. The decreased thermal damage is thought to lead to decreased postoperative pain. There are limited studies with the harmonic scalpel. Several indicate decreased postoperative pain, although other studies showed an increase in the postoperative pain rate, and still others found no difference between traditional electrocautery and the harmonic scalpel technique in terms of intraoperative

blood loss or postoperative hemorrhage.[15] Use of the harmonic scalpel for tonsillectomy may be a promising technique in the future.

Laser Ablation

Lasers have also been used for the performance of tonsillectomy. Initially, they were described in the early 1980s and involved the use of argon plasma coagulation. Good results were obtained in comparison to conventional electrocautery tonsillectomy, and there was a reported reduction in operative time. Subsequently, the CO_2 laser as well as the neodymium : yttrium-aluminum-garnet (Nd : YAG) laser were incorporated to control bleeding. The contact diode laser has also been reported to decrease postoperative pain rates when compared with traditional monopolar cautery. The use of lasers is not routine for the performance of tonsillectomy. Future studies may be needed to further describe techniques for laser tonsillectomy.[16,17]

Powered Instruments

Power tools have recently gained favor for the performance of procedures in otolaryngology, such as sinus surgery and adenoidectomy. They have also been used for tonsillectomy. The majority of reports involve partial tonsillectomy or intracapsular tonsillectomy. There have been reports of lower postoperative hemorrhage rates, as well as rapid recovery, in young children after the use of powered instruments for intracapsular tonsillectomy. This technique does not appear to be feasible for complete tonsillectomy and is therefore listed only for informational purposes.[18,19]

Monopolar Cautery

In a survey of 332 otolaryngologists, the majority (222) performed monopolar cautery procedures and cited decreased blood loss as the reason. The consensus of the majority of studies is that electrocautery dissection is associated with less operative time and intraoperative blood loss compared with sharp techniques. This technique, however, may cause increased postoperative morbidity with respect to pain and return to normal diet and activity. Fifty percent to 60% of otolaryngologists nationally who completed both literature surveys, as well as online surveys, perform monopolar cautery as their technique of choice for tonsillectomy.

Sharp Dissection

Some otolaryngologists continue to use “cold” or sharp dissection techniques to perform tonsillectomy. Of the 73 of the 224 respondents who used sharp dissection, the reason cited was decreased pain.[20] The early techniques of performing tonsillectomy with cold dissection followed by suture ligation was initially used by all otolaryngologists approximately 20 years ago. Now, however, it is used in only 10% of cases nationally.[21]

In summary of the techniques listed, electrocautery appears to be the most commonly performed. There have been numerous articles that have compared electrocautery and cold knife techniques. Electrocautery groups appear to have decreased surgery, anesthesia, and operating room times. There are no reported differences in hemorrhage rates, but there does appear to be a need for significantly more analgesic doses after surgery. The other articles cite a slightly higher rate of hemorrhage with a “steel tonsillectomy technique”.[20–23]

Positioning

Regardless of the technique used, positioning of the patient is critical. A rolled-up towel or blanket under the shoulders is necessary in most young patients because of the relatively large size of their head in comparison to the anterior-to-posterior diameter of their chest. Care must be taken during positioning to ensure that the head is not “hanging” to avoid ligamentous injury to the cervical spine and postoperative neck pain. Patients with Down syndrome may need to be evaluated initially with cervical spine films (extension and flexion) to check for C1-C2 subluxation. Hyperextension of the neck should be avoided at all times, and if possible, procedures on these patients should be performed in a neutral, nonextended manner. Patients with Down syndrome may have unusual laxity of their cervical ligamentous structure, and a shoulder roll should not be used to preclude the risk of subluxation of the cervical spine.

A Crowe-Davis or McIvor mouth gag with a ring blade is gently placed into the patient's mouth with the endotracheal tube securely fixed between the tongue and blade anteriorly and in the midline (Fig. 23-3). The ring blade has the safety feature of a midline groove to accommodate the endotracheal tube. Occasionally, the most difficult portion of the procedure is proper insertion of the mouth gag. The mouth gag should be placed so that the tongue is in the midline position directly behind it. Occasionally, with a large tongue or with a narrow oropharynx or mandibular angle, the mouth gag may need to be repositioned after the procedure is performed on one side. Blades for the mouth gag come in several sizes. Children as well as some adults (women typically) accommodate a no. 3 blade, whereas men are more likely to require a no. 4 blade.

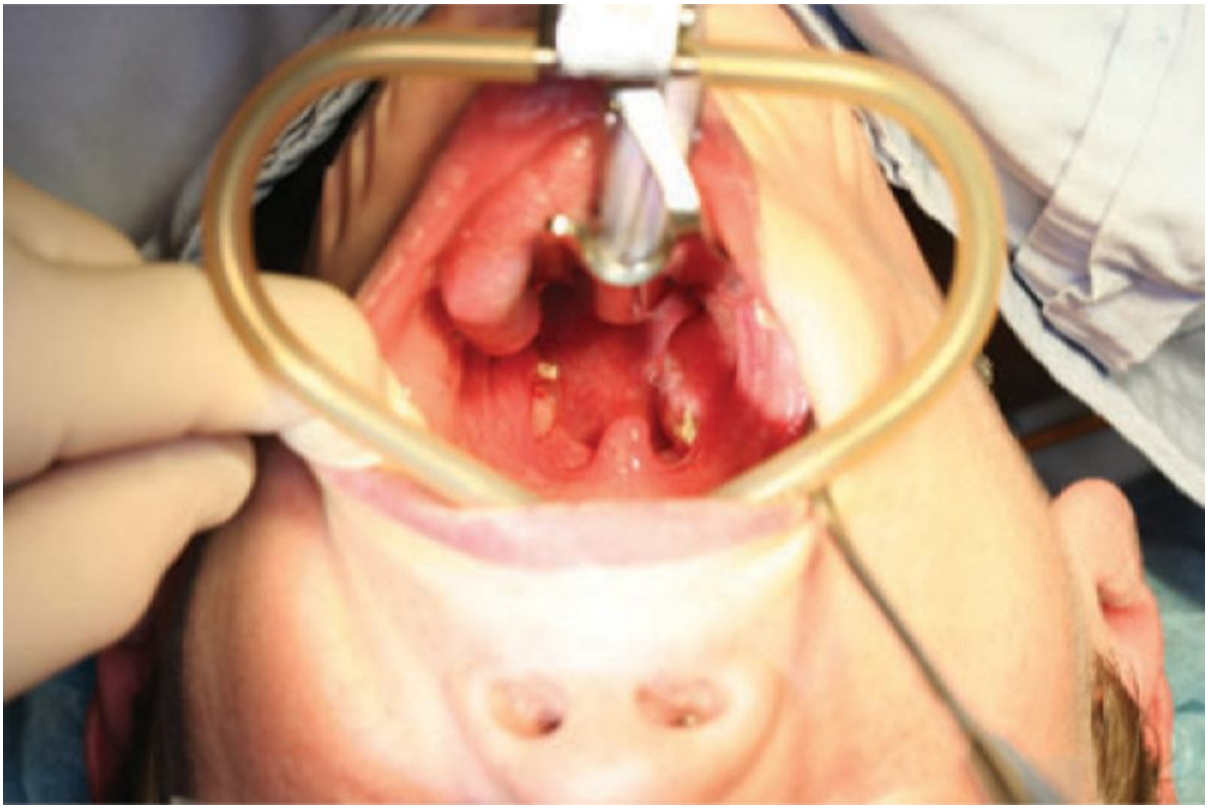

Figure 23-3 Patient with chronic tonsillitis before surgery.

Procedure

Before beginning the procedure, the surgeon must palpate the tonsils, tonsillar fossa, and hard and soft palate. Defects in the soft palate suggest the possibility of a submucous cleft palate and raise the issue of postoperative velopharyngeal insufficiency, especially if adenoidectomy is being contemplated as part of the procedure. Typically, the adenoidectomy is performed before the tonsillectomy. In this case, red rubber catheters are used to retract the soft palate, and a mirror is used to visualize the nasopharynx. Placement of an adenoid or nasopharyngeal pack after the adenoidectomy allows time for bleeding in the adenoid bed to abate during performance of the tonsillectomy. As with tonsillectomy, there have been novel procedures proposed for adenoidectomy.

When the mouth gag is slid into position and displaced inferiorly, care should be taken that the tip of the blade does not traumatize the palate, pharynx, lip, or superior portion of the tonsil, which may result in excessive bleeding. If this occurs and bleeding obstructs the field of view, cautery may need to be performed before beginning the procedure. Once the blade is in position and the endotracheal tube and tongue are centered, the rubber portion of the curved wire is hooked on the lateral incisors or canines of the upper teeth. This should be performed under direct visualization to preclude injury to any loose teeth or to the oropharyngeal mucosa. Such injury is especially a problem in children who are transitioning to adult teeth. Once the mouth gag is opened, careful examination should reveal that the tube is adequately protected, the upper lip is not entrapped, most of the tongue base is covered by the blade, and the tonsils are visible from the superior to the inferior pole. If there is excessive tongue base herniating into the oral cavity, the blade on the mouth gag is too small. If the tongue is so large that it prolapses around the blade, it may become necessary to position the blade for removal of the first tonsil and then reposition it for removal of the second tonsil. With the head extended, the mouth gag is elevated and connected to the Mayo stand on which the instruments to perform the tonsillectomy are placed. Complications may occur from placement of the mouth gag, of which the surgeon should be cognizant. Such complications include dislodgement of teeth, dislocation of the temporomandibular joint, kinking of the endotracheal tube, or accidental dislodgement of the endotracheal tube resulting in premature extubation. Small children require an uncuffed tracheal tube, and it is essential that moist radiopaque gauze be placed in the hypopharynx to prevent escape of oxygen and anesthetic agent from the endotracheal tube during the procedure.

The tonsillectomy is begun by making an incision in the anterior pillar just lateral to the mucosal reflection onto the tonsillar surface. This incision is facilitated by initially grasping the tonsil with curved Allis forceps and retracting it medially and slightly inferiorly to place the mucosa of the anterior pillar under tension (Fig. 23-4). The anterior pillar should be preserved. There has been an article suggesting that deficiency of the anterior tonsillar pillar

predisposes patients to obstructive sleep apnea with increased collapse of the soft palate.[24]

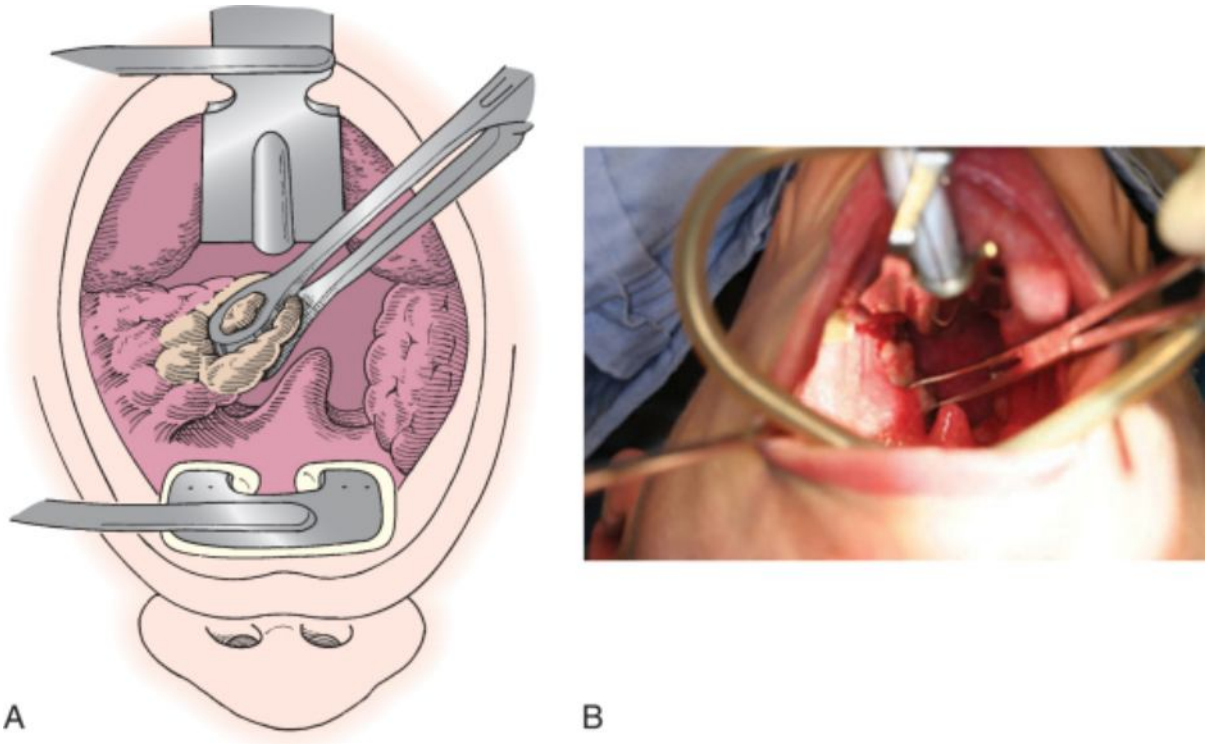

Figure 23-4 **A** and **B**, Placing the tonsil under tension before removal.
*(**A**, Redrawn from Hibbert J: Tonsils and adenoids. In Evans JNG [ed]: Pediatric Otolaryngology. In Kerr AG [ed]: Scott Brown's Otolaryngology, London, Butterworth-Heinemann, 1987, pp 368-383.)*

Examination of the superior pole of the tonsil and the adjacent soft palate during medial retraction of the tonsil will usually reveal the extent of the superior pole above the mucosal reflection before the incision. If the incision is made by electrocautery, it is essentially bloodless and can be carried down without difficulty to the tonsil capsule (Fig. 23-5). It is necessary to dissect the mucosa and underlying soft tissue from the tonsil capsule. Entry into the tonsil at the superior pole is a technical error that leads to difficulty in further dissection of the tonsil because of an inability to identify the plane between the capsule and the surrounding soft tissue.

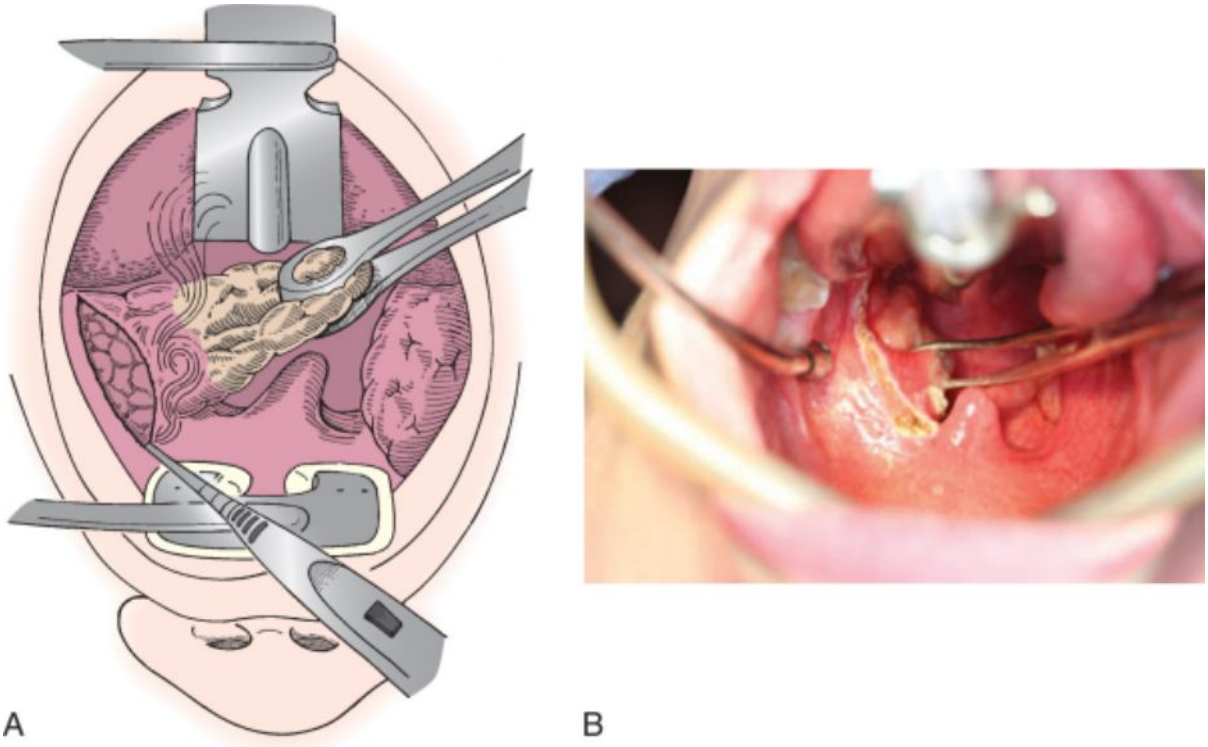

Figure 23-5 Incision of the mucosa with electrocautery and exposure of the capsule. Often it is wise to reposition the clamp at this point in the procedure.
(A, Redrawn from Hibbert J: Tonsils and adenoids. In Evans JNG [ed]: Pediatric Otolaryngology. In Kerr AG [ed]: Scott Brown's Otolaryngology, London, Butterworth-Heinemann, 1987, pp 368-383.)

Once the capsule of the superior pole has been identified, the tonsil is retracted inferiorly. This is often assisted by repositioning the Allis clamp. Countertraction on the soft palate by suction held by the assistant often makes this dissection easier and assists in identification of the correct plane of dissection. If the dissection is performed in a meticulous manner, vessels can frequently be identified as they enter the tonsil capsule and can be controlled with electrocautery before being transected. As the tonsil is dissected inferiorly and freed from the surrounding muscular attachments, the remaining mucosa of the anterior and posterior pillars must be incised (Fig. 23-6). Postoperative discomfort and deformity can be minimized by keeping the line of the mucosal incision immediately adjacent to the tonsil, thereby preserving as much mucosa as possible.

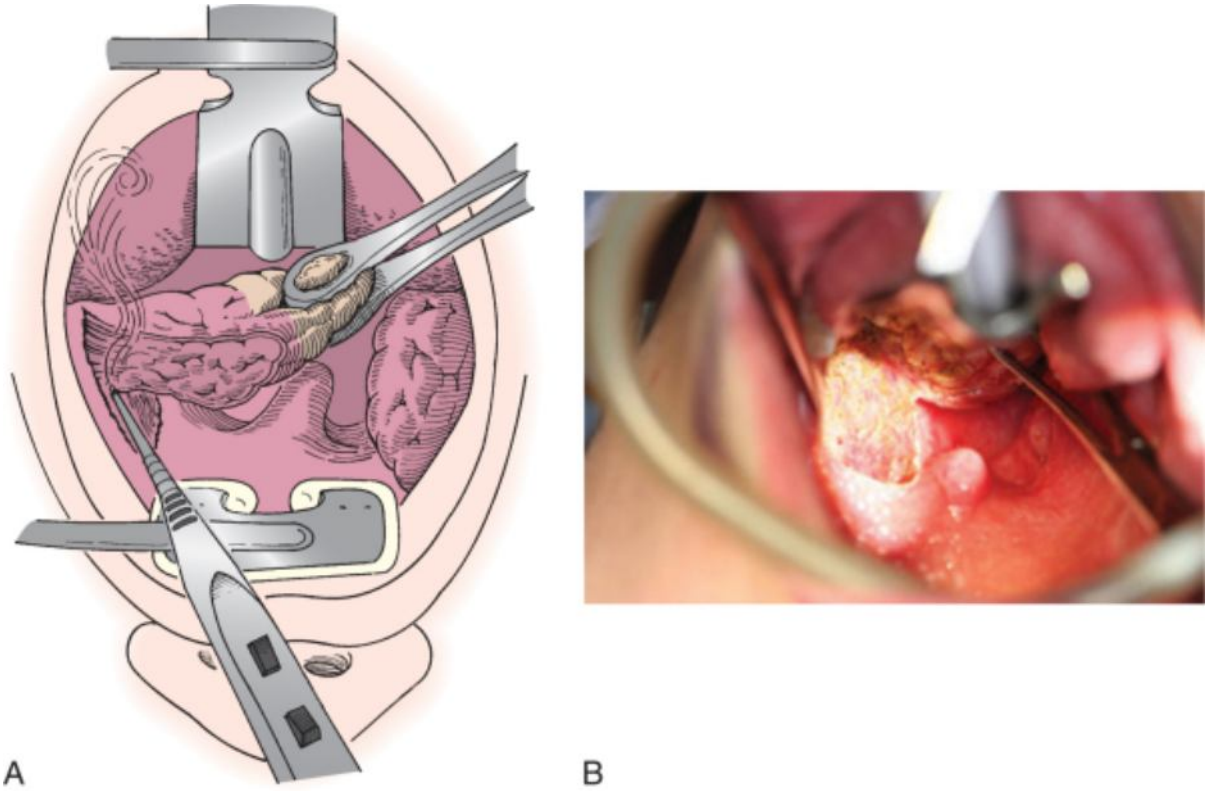

Figure 23-6 Freeing the tonsil from the underlying areolar tissue and the superior constrictor muscle.
(Redrawn from Hibbert J: Tonsils and adenoids. In Evans JNG [ed]: Pediatric Otolaryngology. In Kerr AG [ed]: Scott Brown's Otolaryngology, London, Butterworth-Heinemann, 1987, pp 368-383.)

When the inferior pole of the tonsil has been reached, the tonsil can easily be amputated by electrodissection. Care must be taken to avoid leaving excessive tonsil tissue at the inferior pole, as well as avoid unnecessary excessive dissection into the hypopharynx and tongue base. This latter caveat is particularly important in older patients with massive tonsillar hypertrophy because the tonsillar tissue can extend onto the tongue base and be contiguous with the lingual tonsil.

At the completion of the procedure, the pharynx is irrigated with saline solution. The mouth gag should be closed and opened once or twice to ensure that bleeding is not being controlled merely by mouth gag compression. If no bleeding is evident, the pharynx is suctioned and the patient is returned to the anesthesia staff for awakening and extubation. If at any time during this period there appears to be evidence of bleeding, the surgeon should immediately examine the pharynx and control the bleeding. If bleeding occurs before extubation, the patient should be reanesthetized and the bleeding controlled before extubation. If bleeding occurs after extubation, rapid clinical judgment is necessary to determine whether reintubation is warranted.

The most critical part of the surgical procedure may be awakening from anesthesia. Difficult emergence from anesthesia and extubation with coughing and “bucking,” wild thrashing of the head and thorax, or laryngospasm

triggered by blood and secretions on the vocal cords can result in immediate postoperative bleeding and, occasionally, airway catastrophe. It is of vital importance that the surgeon understand airway dynamics and be in the operating suite when the patient is emerging from the anesthesia during the extubation process.

It is critical that the operating room team not remove electrocautery devices or the suction tubing before the patient exits the operating room in case of postoperative hemorrhage or complications during the wakening period. Intervention frequently requires the ability to rapidly examine the hypopharynx and remove blood clots. This may be crucial to ensuring an uneventful emergence from general anesthesia.

When the tonsil has been removed, it should be properly labeled regarding right and left before sending the specimen to pathology. This is especially applicable if there is concern regarding squamous cell carcinoma or lymphoma. Appropriate patient information should be sent with the pathology request form so that the pathologist can perform either careful entire sections or routine sections (that may miss a small foci of carcinoma). Discussion with the pathologist regarding clinical suspicion is always appropriate. If lymphoma is suspected, the tissue may need to be handled according to specific guidelines as dictated by the pathology department within the institution. Knowledge of the specific institutional policy regarding histologic examination, the specific complaints of the patient, and the need for microscopic examination will dictate the appropriate comments on the pathology request form. It is important to realize that in many institutions, histologic examination of the tonsils is *not* routine. If the tonsillectomy is performed as part of a diagnostic evaluation for an unknown primary cancer, the entire tonsil must be sectioned because the cancer may be microscopic. In these cases, discussion with the pathologist is the best way to avoid inappropriate handling of the specimen. If lymphoma is suspected, the tissue must be handled very gently to avoid distortion of the architecture of the tonsil.

To achieve hemostasis with suction electrocautery, the area of bleeding is initially suctioned and the tip of the suction electrocautery is positioned for several seconds on this bleeding site. Occasionally there is profuse bleeding. The suction portion of the suction cautery may be used, as well as a pediatric Yankauer suction. With the two suction devices at hand, the bleeding source is often more readily identified. Despite this technique, if bleeding continues with an unidentifiable focus point, a tonsil sponge may be placed for several minutes to further control the bleeding and identify the site that requires attention. Alternatively, the bleeding vessel may be grasped with the tonsil hemostat and retracted medially. The hemostat may then be touched with the electrocautery by the assistant. During this procedure, however, care should be taken to ensure that other portions of the hemostat are not in contact with the tongue, gingiva, or lips. Hemostasis may also be achieved with sutures and ties. Although these techniques are occasionally difficult to perform, they are useful to control diffuse areas of bleeding. Suturing is usually performed with absorbable material and a tapered needle. Care must be taken to not pass the needle too deeply into the fossa because large vessels may be encountered and punctured, thereby further exacerbating the problem.

Quality of Life

Parent satisfaction after adenotonsillectomy is quite pronounced. One study in which the parents of 664 children who underwent adenotonsillectomy were polled with a questionnaire showed a high rate (91%) of parent satisfaction after tonsillectomy.[25] Tonsillectomy and adenoidectomy have been shown by some to significantly decrease health care costs in children with obstructive sleep apnea syndrome. There is a reported 33% reduction in annual health care costs in children who underwent tonsillectomy and adenoidectomy; however, the health care costs were decreased as a result of decreased admissions, department visits, consultations, and medications prescribed.[26]

Children undergoing adenotonsillectomy for obstructive sleep apnea had improved quality of life on domains of sleep disturbance, physical symptoms, emotional symptoms, and daytime functioning as reported by their caregivers.[27]

Other studies have shown that not only is there an improved parent satisfaction rate but there is also an improvement in the behavioral response of children after tonsillectomy and adenoidectomy.[28]

Obstructive Sleep Apnea

Obstructive sleep apnea in children, as well as adults, is an indication for tonsillectomy. Although recurrent tonsillitis is cited as the most common indication for performance of tonsillectomy in adults and older children, it is usually hypertrophy or obstructive sleep apnea that is a more common indication for tonsillectomy in children. Rosenfeld and Green reported that the frequency of obstructive sleep apnea rose from 0% in 1978 to 19% in 1986 as an indication for tonsillectomy in children.[29]

The reported incidence of obstructive sleep apnea or hyperventilation syndromes varies within the literature. There is a high incidence of snoring in children, however, with approximately 27% of children habitually snoring in the age group from birth to 10 years.[30] Even in preschool children this incidence is greater than 10%.[31] The incidence of

obstructive sleep apnea, however, has been reported to be 1% to 3% in the pediatric population.[32]

Unlike adult manifestations of obstructive sleep apnea in which patients may have hypertension, right-sided heart failure, and cardiac abnormalities, the majority of children have less severe clinical manifestations, snoring, restless sleep, daytime somnolence, and behavioral disturbances and enuresis. Polysomnography, which is the “gold standard” for diagnosis in adults, is not always performed in children. Often the diagnosis is made clinically, although in one study only half the children with symptoms suggestive of obstructive sleep apnea actually had the condition as confirmed by polysomnography. This may suggest an observation period rather than surgical correction as the treatment of choice.[33] Polysomnography in childhood obstructive sleep apnea differs from that in the adult state. Children usually have fewer discrete obstructive episodes. The criterion that obstructive apnea events be longer than 10 seconds is inappropriate, in part because of children's higher respiratory rates. Patients generally exhibit patterns of hypoventilation characterized by snoring and paradoxical rib cage motion. It is therefore crucial that analysis of polysomnography be performed in laboratories skilled in pediatric problems. The peak age for adenoid and tonsillar hypertrophy and related obstructive sleep symptoms is 3 to 6 years.[34]

Peritonsillar Abscess

Peritonsillar abscess occurs when there is a collection of purulent exudate in the space between the tonsillar capsule and the loose areolar tissue separating the tonsillar capsule from the superior constrictor muscle. These abscesses are thought to occur secondary to acute tonsillitis. The walls of the abscess cavity are composed of the tonsillar capsule medially and the superior constrictor muscle laterally. Patients with a peritonsillar abscess usually have a several-day history of unilateral sore throat, unilateral otalgia, and odynophagia. Physical examination reveals trismus, unilateral erythema of the tonsil, deviation of the uvula, soft palate fullness or peritonsillar bulging, and dehydration. Frequently it is difficult to differentiate peritonsillar cellulitis from peritonsillar abscess. The simplest way to distinguish the two is to aspirate the peritonsillar bulge or soft tissue fullness. Treatment of peritonsillar abscess, once properly diagnosed, is incision and drainage, hydration, and antibiotic therapy. The resulting anaerobic and gram-positive bacteria may spread through deep fascial planes in the neck and rapidly progress to a more serious infection. This condition therefore needs to be promptly addressed. Peritonsillar abscess has an incidence of approximately 30 per 100,000 patients, which accounts for approximately 45,000 cases of peritonsillar abscess per year.[35] The goal of peritonsillar abscess management is to provide quick resolution of the abscess, as well as prevent recurrence. Although incision plus drainage, as well as hydration and antibiotic therapy, has been the mainstay of acute management, the decision whether to perform tonsillectomy, in addition to the timing of tonsillectomy, remains controversial.

Parker and Tami, in an analysis of the literature, suggested that individuals older than 40 years who have a peritonsillar abscess were more likely than younger patients to experience only one episode. As a result, a single peritonsillar abscess occurring in a patient older than 40 years most likely does not require tonsillectomy.[35]

However, patients who are younger than 40 years, who have experienced multiple episodes of tonsillitis, and who have had previous peritonsillar abscesses should be considered for tonsillectomy. Although the recurrence rate for peritonsillar abscess has been reported to be 0% to 30%, reviews of studies have found that possibly 90% of patients who do have a peritonsillar abscess do not suffer recurrence. Additionally, only approximately 30% of patients who have peritonsillar abscesses have a history of recurrent tonsillitis.[35] Patients who experience recurrent peritonsillar abscesses and have a history of recurrent tonsillitis would benefit by tonsillectomy. On the other hand, patients who are younger than 40 may be eligible for tonsillectomy either in the acute setting, known as “quinsy” tonsillectomy, or in the delayed setting. The controversy involves the timing of the tonsillectomy. When performed in the acute setting known as “quinsy” tonsillectomy (quinsy was the name applied to peritonsillar abscess at one time), the procedure ensures resolution of the problem with a single hospitalization and avoids protracted recovery after drainage of the abscess. There is, however, an increased incidence of bleeding intraoperatively that may lead to more difficult dissection.

Opponents point out that the risk of local tissue sepsis secondary to operating in the midst of an acute infection is significant. Moreover, they suggest that there is an increased risk for bleeding, which can be particularly difficult to manage if one attempts to use the suture or tie technique. Furthermore, with limited access to operating room time in many facilities, scheduling an interval tonsillectomy seems more rational than attempting to perform quinsy tonsillectomy on an emergency basis.

The actual performance of quinsy tonsillectomy is very similar to that of routine tonsillectomy in that an incision is made in the anterior pillar to enter and evacuate the abscess cavity, after which the tonsil is dissected free and removed with either electrocautery or a snare. Hemostasis is obtained with electrocautery.

POSTOPERATIVE CARE

An essential in the postoperative care of patients is an understanding of expectations after surgery. During discussions with the patient's caregivers regarding anesthetic risks such as nausea and vomiting; pain, otalgia,

odynophagia, halitosis, and dehydration should be extensively discussed. Treatment plans, including diet, should be discussed. Intravenous fluids are continued until the patient awakens sufficiently to begin oral intake. Routinely beginning a liquid diet with progression to a soft diet is standard. Patients who are unable to tolerate an adequate oral diet, have excessive vomiting, or have evidence of bleeding should not be discharged on the same day but rather be observed until they stabilize. There is also controversy regarding hospitalization of patients based on age. In general, patients who have an unusual postoperative recovery or are younger than 2 years and have a history of obstructive sleep apnea should be admitted to the hospital for overnight observation.

Most surgeons advocate postoperative administration of antibiotics. A randomized study by Grandis and associates revealed decreased pain and fetor oris in patients treated with antibiotics postoperatively.[36] Choices should include an antibiotic that is active against oral flora, usually an oral form of penicillin. Patients who have undergone tonsillectomy for acute infection or peritonsillar abscess or who have a history of recurrent streptococcal pharyngitis should be treated with antibiotics, possibly including perioperative intravenous antibiotics. The use of prophylactic perioperative antibiotics should be routine in any similar procedure when performed on a patient with a cardiac abnormality. The role of antibiotics is to decrease postoperative pain, perhaps by decreasing pharyngeal inflammation secondary to bacterial colonization. The majority of otolaryngologists do routinely administer antibiotics with the knowledge that antibiotics may decrease pain, improve oral intake, and reduce oral odor.[20]

The use of steroids has recently become popular. The most commonly used perioperative steroid is dexamethasone, which apparently decreases nausea and vomiting and leads to improved pain control. However, there are reports of both measured benefit and lack of improvement after the administration of steroids. It appears that in the early postoperative period, children who receive dexamethasone seem to have less morbidity secondary to an antiemetic effect. After 24 hours, however, there does not appear to be any measurable differences, so a single perioperative dose may be warranted.[37,38]

Analgesics should be prescribed as necessary; however, excessive analgesia can result in decreased oral intake and lethargy and may lead to worsening of nausea and vomiting, and ultimately dehydration. Usually, narcotics such as Tylenol with codeine or oxycodone (Roxicet) have been incorporated. Narcotics have in many cases been replaced with nonsteroidal anti-inflammatory drugs (NSAIDs). There are reports of decreased emesis with the use of NSAIDs. The decreased postoperative nausea and vomiting may be offset, however, by a higher incidence of bleeding. Therefore, the use of NSAIDs as an alternative to narcotics or opioids should be done with caution.[39,40]

COMPLICATIONS

Postoperative bleeding is the most common and potentially most devastating complication after tonsillectomy. Bleeding occurring during the first 24 hours is known as *early* (or primary) bleeding and is probably due to inadequate hemostasis at surgery; *late* or delayed bleeding generally occurs 7 to 10 days after the procedure. The cause of late bleeding is unclear.[41] Although bleeding rarely results in rapid exsanguination, it can result in airway compromise. Inappropriate treatment can lead to a series of events that may even result in demise of the patient. Death can occur as a result of an inability to control the airway in the midst of a blood-filled oral cavity and oropharynx. Care must be taken during the repeat operative procedure (for control of tonsillar bleeding) to avoid undue trauma to the surrounding tissue that can result in difficulty in hemostasis. Careful dissection on the tonsil capsule will avoid exposing the vessels deep within the constrictor muscles and facilitate hemostasis both intraoperatively and postoperatively.

Coagulation Disorders

Although the majority of patients do not have any coagulopathies, in a survey conducted by the AAO-HNS, otolaryngologists often did obtain complete blood counts. The likelihood of obtaining blood tests preoperatively was decreased in members of the American Society of Pediatric Otolaryngologists.

Hemorrhage can occur late after tonsillectomy as a result of both technical and unpreventable patient factors. Sutures placed through large vessels can result in bleeding when the suture is absorbed and the lumen of the larger vessel is exposed. For this reason, if bleeding increases during suture placement, the suture should be removed rather than tied. Similarly, electrocautery deep within the tonsillar fossa can result in injury to the wall of major blood vessels (such as the internal carotid artery), which can be manifested as devastating bleeding days to even weeks after completion of the procedure. Cautery should be conservative and localized to bleeding sites. It should not be used deep within a torn muscle bed or lateral to the plane of the superior constrictor.

Patients must be advised regarding the need to continue oral intake. Patients who refuse to swallow are subject to increased swelling of their soft palate because of immobility and increased debris and secretions. They may require admission for intravenous hydration as a result of an inability to maintain adequate oral intake.

Control of Postoperative Hemorrhage

All patients should undergo an examination of the oral cavity before discharge, including examination of both tonsillar fossae to rule out the presence of a clot. A clot within a tonsillar fossa can be assumed to represent underlying bleeding. The clot should be removed and the tonsillar fossa inspected. If a clot is present or frank bleeding is visualized, either immediately postoperatively or days later, tonsillar bleeding is occurring and intervention is necessary.[42]

Vital signs, pulse and blood pressure, should be obtained immediately and monitored closely. If airway distress is present, oxygen saturation should be monitored with a pulse oximeter. The surgeon needs a headlight for examination because both hands will be required for management. Young children and uncooperative older patients will require general anesthesia, although most patients older than 5 or 6 years will tolerate a certain degree of manipulation, and general anesthesia can often be avoided in these patients. Instrumentation should be obtained, and assistance will be required. Most hospitals have prepared “T&A hemorrhage trays.” These trays should be examined before they are actually needed. The patient is best examined in a sitting position or in a semisitting position on a stretcher.

The pharynx can be sprayed with a topical anesthetic such as benzocaine, tetracaine, and benzalkonium (Cetacaine). Care must be taken to not overanesthetize the pharynx and hypopharynx because doing so can result in aspiration secondary to ablation of the laryngeal protective reflexes. In a similar manner, sedation should be either avoided or minimized. Using a tongue blade for retraction and suction, the clot can be removed from the tonsillar fossa. Even if there is no further bleeding, inpatient observation is warranted. If the bleeding point is visualized, injection of 1% lidocaine (Xylocaine) with epinephrine 1 : 100,000 into the tissue immediately adjacent to the bleeding vessel may result in cessation of the bleeding. Once an injection has been performed, cauterization with either electrocautery or silver nitrate may be efficacious in controlling the bleeding. If these maneuvers are not successful, a figure-of-eight suture may be placed. This requires an exceptionally cooperative patient and significant hand-eye coordination on the part of the surgeon for accomplishment in an awake patient.

If the previously described efforts are unsuccessful and bleeding continues, if the patient is uncooperative, or if the bleeding is massive, general anesthesia will be required. Anesthetizing a patient with postoperative tonsillar bleeding can be a challenge for the anesthetist. The surgeon should insist that the most experienced and skillful anesthesiologist be available for the induction. The patient may be hypovolemic, combative, and suffering airway compromise because of the volume of blood in the mouth. Moreover, because the stomach is usually filled with blood and other secretions, the risk of perioperative aspiration is significant. Control of hemorrhage with direct pressure to permit fluid resuscitation and suctioning of blood from the pharynx may be lifesaving. Care must be taken to avoid aspiration of blood and stomach contents by overzealous local and topical anesthesia of the pharynx, hypopharynx, and larynx. Patients who are hypovolemic must have their fluid and blood deficits replaced as rapidly as possible during preparation for anesthesia. The combination of hypovolemia and hypotension from anesthetic agents may produce cardiovascular arrest.

Rarely, patients will have a history of vigorous bleeding, which then stops spontaneously. When presented with such a “sentinel bleed,” the possibility of internal carotid injury must be entertained. If the patient is not bleeding at the time, angiography may provide the diagnosis, as well as an opportunity for balloon occlusion of the artery if the patient can tolerate loss of a carotid artery. Emergency angiography is probably preferable to emergency surgery in this situation if personnel with the appropriate skills and equipment are available in the facility.

In addition to the complications described, rare complications include hypernasal speech, pharyngeal stenosis, and lesions of the tongue, teeth, tonsillar pillars, soft palate, or uvula. Although the complications themselves have remained the same, the complication rate has decreased, no doubt as a result of better training of otolaryngologists, anesthesiologists, and paraprofessional staff.

CONCLUSION

Tonsillectomy is a commonly performed procedure that is effective in the control of recurrent pharyngitis, management of peritonsillar abscess, and treatment of upper airway obstruction and sleep disturbances secondary to tonsil hypertrophy. It is occasionally performed for biopsy of a tonsillar mass or in a search for an unknown primary tumor. It is often performed in conjunction with adenoidectomy in young children. Various surgical techniques are available; we favor use of the electrocautery technique with discrete vessel electrocautery for hemostasis. The rate of postoperative bleeding can range from 1% to 4%, and it is a serious management challenge for the otolaryngologist–head and neck surgeon. Tonsillectomy is not an easy operation and must be viewed with respect because of its potentially fatal outcome. Current indications are rigorous and, if followed, will result in the selection of only patients who will benefit from the procedure.[43]

PEARLS

- Tonsillectomy is most commonly performed for recurrent infections.
- Identification of the plane between the capsule of the tonsil and the constrictor muscle, regardless of the method used for removal, will facilitate the procedure.
- Grasp as much of the tonsil as possible before beginning the dissection to prevent repeated handling of tonsillar tissue during the dissection.
- With the tonsil retracted medially and the tonsillar tissue under tension, coagulate any bleeding or visible vessels.
- Irrigate the tonsillar beds before reversal of anesthesia to visualize any oozing vessels that might not be apparent in an existing bloody field.

PITFALLS

- Failure to identify the proper plane of dissection, especially in the superior pole of the tonsil where the tonsillar tissue may extend more laterally than expected, may result in cumbersome bleeding.
- Permitting ancillary staff to remove the tonsillectomy equipment before the patient exits from the room may lead to a delay in visualizing and controlling immediate bleeding.
- “Chasing” inferior pole tonsillar tissue rather than creating an arbitrary transition of tonsillar lymphoid tissue from lingual lymphoid tissue may result in troublesome immediate and delayed bleeding.
- Failure to consider von Willebrand's disease in a patient who provides a preoperative history of previous unexplained postsurgical bleeding may result in postoperative bleeding.
- Failure to relax the McIvor mouth gag between the right and left tonsillectomy procedures may result in complaints of painful paresthesias of the tongue postoperatively and possible bleeding during emergence from anesthesia intraoperatively.