Research Papers

Surgical management of the tonsillectomy and adenoidectomy patient

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Tonsillectomy and adenoidectomy were developed hundreds of years ago, but they enjoyed wide popularity beginning in the early 20th century as a preventive treatment of Group A beta-hemolytic streptococcal (GABHS) pharyngotonsillitis and its feared complication - rheumatic heart disease. During that era, many children underwent tonsillectomy and adenoidectomy that was not indicated due to a negative history of streptococcal infection, but became surgical candidates because another family member suffered frequent streptococcal disease or worse - rheumatic heart disease. Development of potent antibiotics, specifically penicillin, altered the treatment of recurrent streptococcal disease, and decreased the incidence of rheumatic fever and heart disease. Along with a decrease in the incidence of tonsillectomy and adenoidectomy, there have been marked improvements in both surgical and anesthetic techniques that have decreased both morbidity and mortality. While tonsillectomy and adenoidectomy have become much safer in the past fifty years, postoperative complications still exist but can be minimized by careful history-taking, good surgical technique and excellent attention to detail postoperatively.

Indications for tonsil and adenoid surgery

Recurrent infection/recurrent tonsillitis

Symptoms and signs of GABHS infection are often difficult to distinguish from other bacterial or viral pharyngitis. In the Pittsburgh pharyngotonsillitis study reported by Paradise et al,[1] the following symptoms and signs — sore throat, fever ($>38\ °C$), tonsillar exudates, cervical lymphadenopathy, drooling, muffled voice, malaise and a positive culture for GABHS — were inclusive for the study. All of these symptoms and signs can be seen with viral infections, and so the gold standard of proof for GABHS infection remains the throat culture. Rapid streptococcal assays are helpful in determining the need for early treatment with antibiotics, but may have false positives.

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Because there is overlap in the symptoms and signs of GABHS compared with either other bacterial or viral infections, recurrent infection as a surgical indication was often difficult to document and categorize which group of patients may benefit from surgery. Paradise reported on criteria for surgery that have separated those children who would benefit from tonsillectomy and adenoidectomy from those whose disease is not severe enough to warrant surgery. The "Paradise Criteria" are listed in Table 1 and remain the standard for surgical decision-making in cases of recurrent pharyngotonsillitis infection. A subsequent report in 2002[2] examined children with milder symptoms and less evidence of streptococcal disease and discussed the indications for adenotonsillectomy in this group of patients. Blakely and Magit[3] and Burton[4] conducted meta analyses that demonstrated improvement of chronic sore throats following tonsillectomy and adenoidectomy. Clinical Practice Guidelines for Tonsillectomy and Adenoidectomy[5] mirror the "Pittsburgh Criteria" and represent the current recommendations for performing tonsillectomy in children with recurrent tonsillitis as a cause.

Streptococcal carriage

In spite of the development of potent antibiotics against streptococcal infection, carriage remains a condition that is difficult and controversial to treat. Affected children have positive cultures for GABHS, but have no or minimal symptoms. Some have suggested that streptococcal bacteria reside in biofilms in the tonsil and adenoid tissue, a place where they are difficult to eradicate.[6] Antibody titers both in the convalescent and active infection periods help to confirm carriage from infection. Table 2 lists the major reasons for treatment of streptococcal carriage. Medical treatment for carrier state has been delineated by the Infectious Diseases Society of America guideline in 2012 which listed the following as strong recommendations: Amoxicillin-clavulanate, Penicillin and Rifampin (not rifampin alone) or Clindamycin. Surgical treatment with tonsillectomy and adenoidectomy is curative in resistant cases.

Table 1 Paradise criteria for tonsillectomy in recurrent tonsillitis.

Frequency of sore throat events 7 or more episodes in the preceding year
OR
5 or more episodes in each of the preceding 2 years
OR
3 or more events in each of the preceding 3 years

Table 2 Streptococcal carriage who to treat?

Family history of rheumatic fever
History of acute glomerulonephritis
Ping-pong spread of disease through family
School has GABHS epidemic

Sleep disordered breathing

Sleep disordered breathing (SDB) ranges from upper airway resistance syndrome to obstructive sleep apnea (OSA). Children with upper airway resistance have a normal polysomnogram but symptoms of airway obstruction at night including snoring and straining to breathe. Daytime symptoms of OSA are listed in Table 3, while nighttime symptoms can be found in Table 4. Sleep disordered breathing has effects on other body systems. Cardiovascular symptoms include signs of right heart failure in extreme cases but may include arrhythmias and evidence of right heart strain in milder cases. Growth hormone is secreted during sleep, and secretion of it may be affected by OSA. Controversy still remains as to whether SDB can be associated with neuro-psychiatric effects. The CHAT study failed to show improvement of neuro-psychiatric effects following tonsillectomy and adenoidectomy, but did confirm that other behavioral abnormalities associated with SDB improved following surgery.[7] While enuresis as a symptom of OSA remains controversial, several studies have suggested an association.[8,9]

Polysomnography remains the "gold standard" for diagnosis of SDB. In children, the procedure is usually performed in a controlled environment (not home) because a sleep technician is necessary to ensure all of the equipment remains in place. Since some children are on positive airway pressure (CPAP or BiPAP), a respiratory therapist may need to be present to monitor the patient.

Tonsillectomy and adenoidectomy is curative in most, but not all cases of OSA. Children with co-morbidities, high body mass index (BMI) or unfavorable anatomy may require non-surgical treatment such as CPAP or BiPAP. Table 5 lists the usual monitors employed in polysomnography. Parameters of most interest in children with SDB include the apnea-hypoxia index (AHI), the oxygen desaturation nadir and evidence of hypercapnia.

Table 3 Daytime symptoms of obstructive sleep apnea.

No daytime symptoms
Chronic mouth-breathing
Chronic rhinorrhea
Change in quality of speech
Anosmia
Choking or gagging on food
Decreased appetite
Prolonged eating time
Food preferences
Morning headaches
Behavioral problems

Table 4 Nighttime symptoms of obstructive sleep apnea.

Snoring, gasping, choking, cough	Frank apnea
Sleepwalking	Sleep talking
Night terrors	Diaphoresis
Enuresis	

Table 5 Polysomnography monitors.

Chest wall movements (impedance or strain gauges)
Thermistors (to measure oral and nasal airflow)
EKG
Pulse oximetry
EEG
End tidal carbon dioxide
Elective monitors: electrooculography (EOG), suprahyoid EMG, pH probe

Peritonsillar abscess

Peritonsillar abscess results during an episode of acute pharyngeal infection when pus collects between the capsule of the tonsil and the surrounding pharyngeal constrictor. An additional etiology has been proposed — that an infection of Weber's glands, a group of minor salivary glands in the supratonsillar fossa — is the cause of the abscess.[10] Affected children complain of severe sore throat, trismus, fever and altered voice. The child is treated initially with intravenous antibiotics, and small abscesses may be managed in the ambulatory setting with either needle aspiration or incision and drainage followed by a course of oral antibiotics. Tonsillectomy (quinsy tonsillectomy) remains a treatment option if other methods fail or in the presence of a long history of recurrent infection. If not performed acutely, a tonsillectomy should be deferred for at least six weeks to allow the acute infection to completely resolve.

Chronic/cryptic/hemorrhagictonsillitis

Older children and adolescents may present with symptoms of chronic tonsillitis. Most patients complain of sore throat, halitosis, tonsillith production and rarely, bloody saliva. Most of these patients do not have recurrent streptococcal disease, but are infected with other bacteria or viruses. Female patients outnumber males in the older teenage age group by 5—6 to 1 ratio. A trial of clindamycin may be curative, reducing pain and tonsillith proliferation. Tonsilliths may also be removed with a Q-tip, dental irrigation device or water flosser. Tonsillectomy is a viable surgical option if conservative efforts fail.

PFAPA syndrome

PFAPA syndrome consists of a constellation of symptoms including periodic fevers, aphthous stomatitis, pharyngitis and adenitis. Diagnostic criteria are listed in Table 6. The etiology of PFAPA syndrome appears to be genetic, as with other periodic fever syndromes. Although a gene has not yet been identified for this disorder, and there is no available specific laboratory test for the diagnosis of PFAPA, the dramatic response to treatment with steroids may help confirm the diagnose. PFAPA symptoms often improve with time in some children. Licameli showed resolution of symptoms in 26/27 patients following a tonsillectomy.[11] Garavello showed complete resolution in 64% of surgical patients compared to 5% of controls.[12]

PANDAS syndrome

PANDAS (Pediatric Autoimmune Neuropsychiatric Disorders Associated with Streptococcal Infection) syndrome remains a controversial entity, and the value of performing a tonsillectomy in affected patients remains uncertain. Diagnostic criteria for this disorder are listed in Table 7. In patients thought to have PANDAS, GABHS infection appears to trigger the development of anti-neuronal antibodies that cross-react with cells in the basal ganglia, in a manner similar to Sydenham's chorea. Antistreptolysin O (ASO) titers appear to increase and decrease with exacerbations of symptoms, but stressors such as viral infections, fever or fatigue can cause symptoms at a time when ASO titers are low or negative. Medical treatment includes antibiotics (with trials both supporting and not supporting improvement), plasma exchange and intravenous immunoglobulins. Because numbers of affected patients are small, efficacy of surgical treatment, specifically adenotonsillectomy, remains difficult to determine.

Tonsillar asymmetry

Tonsillar asymmetry is very common, but in the past has initiated concern for a possible malignancy (usually lymphoma) in the larger tonsil. In most cases of tonsillar asymmetry, the tonsils may be the same size with one tonsil being situated more superficial in the fossa than in the contralateral side. In the distant past, the accepted management of tonsillar asymmetry was to excise the tonsil. Studies have shown this to be unnecessary in almost all cases. The current teaching is to remove any tonsil that is enlarged with changes in the overlying mucosa and associated with jugular lymphadenopathy on the same side of the neck. Constitutional symptoms in association with tonsillar asymmetry are very suspicious for a malignancy. Patients with tonsillar asymmetry alone should be monitored.[13]

Effects on dental and facial growth

The literature includes studies that both support and fail to support any abnormalities of either dental or facial growth

Table 6 Diagnostic criteria PFAPA syndrome.

Onset prior to age 5
Regular bouts of fever lasting 5 days associated with constitutional symptoms
Asymptomatic between infections
Exclusion of cyclic neutropenia or similar syndromes
Exclusion of autoimmune, immunodeficiency or chronic infection syndromes

Table 7 Diagnostic criteria PANDAS syndrome.

Pediatric onset
Obsessive compulsive or tic disorder
Episodic course of severity
Association with GABHS infection
Association with basal ganglia dysfunction

related to chronic mouth-breathing that results from adenotonsillar hypertrophy. An adenoid facies may be seen in cases of severe nasal obstruction, and recognition of this uncommon finding is an indication for an adenoidectomy. Further discussion of this complicated issue is beyond the scope of this article.

Indications for adenoidectomy alone

Adenoidectomy alone should be considered in cases of nasal obstruction (in the absence of significant sleep-disordered breathing), chronic adenoiditis and sinusitis and recurrent otitis media. Adenoid size is best assessed by a lateral neck radiograph or with nasopharyngoscopy. Adenoidectomy has also been shown to improve outcomes in the management of chronic ear infections and otitis media with effusion.[14]

United States demographics

As of 2006, the number of adenotonsillectomies, tonsillectomies alone and adenoidectomies alone are listed in Table 8.[15] Between the early 1970's and early 2000's, there was an increase in the incidence of tonsillectomy from 126/100,000 to 153/100,000.[16] An even larger increase in adenotonsillectomies from 243/100,000 to 485/100,000 was seen during the same period of time.[16] The mean age for tonsillectomy alone was 15.9 years, while the mean age for adenotonsillectomies was 6.8 years.[16] There is a bimodal peak for tonsillectomy at age 5—8 and again between ages 17—21. This second peak occurs mostly in females with chronic tonsillitis as an indication. Overall the incidence of females undergoing both a tonsillectomy and adenoidectomy is 48%, but the incidence for tonsillectomy alone is 65%.[16]

Surgical techniques for tonsillectomy and adenoidectomy

As advances in surgical technologies have occurred in the last 35 years, so have the number of techniques for tonsillectomy and adenoidectomy (Table 9). The cold technique utilizing the Hurd dissector, the Fisher knife and the snare is a time tested technique that has the advantage of less pain, depending upon the amount of cautery necessary to achieve hemostasis. The incidence of secondary bleeding

Table 8 Demographics of tonsil and adenoid surgery.

506,778 ± 32,054 Tonsillectomies and adenoidectomies
58,111 ± 9645 Tonsillectomies
129,540 ± 15,714 Adenoidectomies

Table 9 Surgical techniques for tonsil and adenoid surgery.

Cold technique	Microdebrider
Monopolar cautery	Harmonic scalpel
Bipolar cautery	Ablation
Coblation	KTP/CO$_2$ laser

may also be less,[17] but that remains a controversial issue. The disadvantages of this technique include longer surgical time, more surgical blood loss and a higher incidence of primary bleeding within the first 24 h of surgery.

Since its description in the early 1980's, monopolar tonsillectomy has been a popular technique for tonsillectomy. The monopolar cautery is used to dissect the tonsil from its fossa in the plane between the tonsillar capsule and the surrounding pharyngeal musculature. Because there is minimal bleeding, the operative time is shorter, and there is less operative or primary bleeding. Multiple studies have suggested more postoperative pain and a slightly higher incidence of secondary bleeding than some of the other techniques.[18,19]

Using bipolar cautery, either in the form of forceps or a scissors may result in less thermal injury, and therefore less pain. This method also has less operative bleeding compared to the cold technique and may require less operative time.[20]

Coblation or ablation uses radiofrequency bipolar current to break molecular bonds. The coblator is used to excise tissue, while ablation is used to shrink tissue. Coblation operates at a lower temperature than cautery (70 °C vs. 400 °C) and may produce less postoperative pain than the cautery.[21]

Use of a microbrider to remove the tonsils introduced a whole different approach to tonsillectomy—intracapsular tonillectomy.[22] Instead of completely excising the tonsil, most of the tonsil is shaved from the fossa, leaving a small rim of tonsil tissue. Leaving this rim of tissue appears to result in less postoperative pain. The downside of this procedure is that the residual rim of tissue may develop tonsillar regrowth. There may be more operative bleeding with intracapsular tonsillectomy, but less secondary bleeding.

The harmonic scalpel is a device that uses ultrasonic energy to cut tissue and coagulate. Like coblation, the harmonic scalpel operates at a lower temperature (50—100 °C). For this reason, there may be less postoperative pain. Like coblation, use of the harmonic scalpel may be less cost-effective than the other techniques, and studies to date have not shown superior value of one technique over another.[23]

Use of the laser, either KTP or carbon dioxide, has been reported. Because there is less adjacent thermal injury, the laser appears to cause less operative bleeding and pain compared to the cold technique, but use of the laser for adenotonsillectomy is certainly not cost-effective. There is also increased risk of airway fire with the use of the laser.

Many of the techniques for tonsillectomy have also been applied to adenoidectomy. A cold technique using either a curette or adenotome excises the tissue, and hemostasis is provided by suction cautery. Suction cautery utilizing a monopolar suction cautery is another technique to both remove and cauterize the adenoid bed. The same results can be achieved with coblation. Use of the microdebrider to excise tissue is another popular form of adenoidectomy. The adenoid bed is then cauterized with the suction cautery.

Postoperative care

Careful attention to maintain good hydration status, prevention of respiratory compromise and management of any

unexpected bleeding are steps that are necessary for the successful postoperative course for a child undergoing a tonsillectomy and adenoidectomy. The following criteria should be considered during the postoperative period.

Inpatient versus outpatient care

Can a child go home or should they remain in the hospital overnight? Up until the 1980's, all children remained in the hospital for at least one night and often several days until they were deemed fit to return home. Currently, most children between the ages of 3—4 years and without underlying co-morbidities may go home after a period of careful observation for evidence of bleeding, respiratory compromise or suspicion of possible poor oral intake. Unless the child is undergoing just an adenoidectomy and has minimal to no airway symptoms, all children under 3 years of age should stay overnight. Most 4 year olds can go home, while many young 3 years olds don't drink well in the immediate postoperative period. A good age cut-off when considering whether it is safe for a child to leave is 3.5 years. Reasons to keep a child overnight include intractable vomiting, any bleeding, continued apnea or respiratory compromise, long distance to home, unreliable transportation or a sense that the parents will not be able to adequately care for their child in the outpatient setting. When deciding whether to send a child with sleep apnea home on the day of surgery, both the American Academy of Otolaryngology-Head and Neck Surgery and the American Academy of Pediatrics have guidelines that use the apnea-hypopnea index (AHI) on polysomnography to help in the decision making process. The AAO-HNS recommends an AHI no greater than 10, while the American Academy of Pediatrics (AAP) uses an AHI of 24 as an upper limit. Many surgeons use an AHI value somewhere in between (i.e. 15—20) to make that decision. In addition to the AHI, the oxygen saturation nadir is often very predictive of how the child will do in the first 24 h. Those children with an oxygen saturation nadir less than 90% on polysomnography should be considered candidates to stay overnight in the hospital.

Use of corticosteroids

Use of corticosteroids during the operative or postoperative periods has been recommended by AAO-HNS Guidelines.[5] Steroids are thought to prevent nausea and vomiting. Steroids given at the onset of surgery is beginning may reduce swelling of the uvula and soft palate from surgical trauma. Another dose of steroids may be given approximately three days into the postoperative period to improve pain control and increase hydration. Reports that corticosteroids given during surgery may cause an increase in bleeding remain unfounded.[24]

Use of antibiotics

In the past studies have suggested an improved postoperative course with the use of broad-spectrum antibiotics following surgery. More recent reviews have shown no evidence to support use of antibiotics in adenotonsillectomy patients.[5] Avoiding antibiotics prevents the occurrence of drug allergies, drug reactions and antibiotic resistance. The Clinical Practice Guidelines (2011) have a strong recommendation to avoid the routine use of perioperative antibiotic in tonsillectomy patients.[5]

Pain control

Pain control in tonsillectomy patients is crucial to preventing complications of dehydration and bleeding during the postoperative period. The three major drug categories in use today include acetaminophen, oxycodone or hydrocodone and nonsteroidal anti-inflammatory drugs (NSAIDs). In the past acetaminophen and codeine were a mainstay of postoperative pain management. Because of the awareness of ultra-rapid metabolizers of codeine, the FDA has placed a black box warning on the use of this medication in children. For this reason, the combination of acetaminophen and codeine are no longer used in adenotonsillectomy patients. Hydrocodone and oxycodone can be titrated in a much safer fashion and have replaced codeine. Use of NSAIDs has also become very popular in post-tonsillectomy patients, avoiding many of the side effects of narcotics: constipation, nausea, vomiting somnolence, pruritus. In patients without co-morbidites, oxycodone can be used at a dosage of 0.075 $mg \cdot kg^{-1} \cdot dose^{-1}$ every 4—6 h. If this dose is ineffective, it can be increased to a maximum of 0.1 $mg \cdot kg^{-1} \cdot dose^{-1}$. Acetaminophen remains an excellent drug for pain although not as effective as either ibuprofen or the opiates. Because of the concern of overdose in a child who may be dehydrated, care should be taken as to the dose used. Both the suspension and suppository routes should use 10 $mg \cdot kg^{-1} \cdot dose^{-1}$ at 4—6 h intervals. Ibuprofen can be used solely in adenoidectomy patients for pain relief at a 8—10 $mg \cdot kg^{-1} \cdot dose^{-1}$ every 6 h. It can also be used either primarily in tonsillectomy patients (at same dose as adenoidectomy) or as a rescue (at a dose of 5—7 $mg \cdot kg^{-1} \cdot dose^{-1}$) in patients who were initially treated with opiates. A recent study by Pfaff et al[25] demonstrates that there is no increased rate of post-tonsillectomy bleeding when codeine was transitioned to ibuprofen for postop pain control in a large cohort of 6014 patients over a 4 year period. Use of local anesthetics (e.g. bupivacaine) have not been effective in post-tonsillectomy patients.

Complications

Historical complications

In the distant past complications following tonsillectomy and adenoidectomy were often the result of the surgical technique and problems protecting the airway under general anesthesia. Flammable inhalational anesthetics such as ether prevented good hemostasis that can be achieved today using either suction or bipolar cautery or other techniques that employ heat. Development of non-flammable anesthetic agents and protection of the airway during surgery by using endotracheal intubation has resulted in decreases in primary bleeding and pulmonary complications such as aspiration, pneumonia and lung abscess. In the mid-20th century, mortality from tonsillectomy and adenoidectomy made up 9% of all operative mortality. In

the 1960's with improved anesthesia and surgical techniques, the mortality dropped to 1 in 10,000—16,000. Currently, the accepted mortality rate for tonsillectomy patients ranges between 1 in 16,000—35,000.[26]

Common complications

Primary and secondary hemorrhage

Hemorrhage following tonsil and adenoid surgery is typically defined as primary, occurring during the first 24 h, or secondary, occurring after the first 24 postoperative hours. Primary hemorrhage is usually the result of bleeding that was not completely controlled during the surgical procedure or may be due to bleeding that was not initially evident at the time the surgical procedure was completed. Traditionally, packing and ties or suture ligatures were used to control bleeding prior to the development of electrocautery. Some practitioners still use chemical cautery with either silver nitrate or bismuth subgallate. Most centers today use either monopolar electrocautery or coblation cautery, another form of electrocautery. Almost all episodes of primary bleeding respond to a return to the operating room for surgical control.

The etiology of secondary hemorrhage is less clear. Typically when the surgical eschar falls off, no bleeding occurs. In some cases a blood vessel, either arterial or venous, may be exposed and bleed. Secondary bleeding seems to occur following a prodrome of pain and poor oral hydration which suggests a role for hydration status in the development of bleeding. The incidence of secondary bleeding may be related to the technique used for tonsillectomy. Because the capsule of the tonsil is not exposed in intracapsular (microdebrider) procedures, there appears to be a lower incidence of secondary bleeding in intracapsular cases. In many studies, older children and adolescents have a somewhat higher incidence of secondary bleeding.[5]

Some episodes of secondary bleeding are minor and require just careful observation to make sure no further bleeding occurs. The child may be kept NPO, and intravenous hydration can be started. Presence of active bleeding on examination or the presence of a clot in the fossa necessitates a return to the operating room for control of bleeding. Unusual or recurrent bleeding necessitates a hematologic consultation to rule out a coagulation disorder. Rarely a transfusion may be necessary during one of the episodes (0—2.3%).[27] It is important to monitor the incidence of postoperative hemorrhage, so a review of cases on at least an annual basis is recommended.[5]

In patients without a patient or family history suggestive of a bleeding disorder, coagulation studies are usually not obtained. Many centers obtain a preoperative CBC prior to surgery to document a baseline hemoglobin. Use of aspirin or herbal medications affect coagulation and should be avoided several weeks prior to surgery.

Airway obstruction/Respiratory compromise

Patients at risk for airway obstruction or respiratory compromise following tonsil and adenoid surgery have the following characteristics. They are often children under the age of three. Many have severe apnea preoperatively with a high AHI or evidence of oxygen desaturation below 90%. Some patients have breath-holding spells that might be difficult to distinguish from pharyngeal obstruction due to postoperative swelling. Children with underlying neurological problems such as cerebral palsy or a seizure disorder are at greater risk as are children with congenital heart disease, prematurity and either Down or craniofacial syndromes.

Supportive therapy in these patients begins with close observation in an ICU, respiratory ICU or step-down unit that has higher surveillance. Supplemental oxygen, frequent suctioning and re-positioning are essential to maintaining the airway. Additional dosages of steroids may reduce operative edema. Nebulized medications such as racemic epinephrine and albuterol may be indicated depending upon the site of obstruction. If these maneuvers are unsuccessful, insertion of an artificial airway may be indicated. Nasal or oral airways can be helpful, but in some cases, repeat endotracheal intubation is warranted. CPAP or BiPAP may obviate the need for an artificial airway. In some children ventilation may be necessary for a few hours to days until airway edema has decreased.

Dehydration

Dehydration is the third major complication that occurs following tonsil and adenoid surgery. Intravenous fluids may be necessary in many affected patients. Ice chips or icy drinks may help relieve the throat pain while chewing gum or gummy candies help to relax pharyngeal muscles that are in spasm secondary to surgery. Oral or intravenous steroids may also help to reduce edema, improving swallowing. Because the opiate pain medications often cause nausea and vomiting, one should consider switching to a non-opiate pain medication or trying a dose of ondansetron to reduce nausea.

Uncommon complications

Table 10 lists uncommon or rare complications of tonsil and adenoid surgery. Trauma to the teeth may result from improper placement of the mouth gag. Iatrogenic trauma to the uvula and/or soft palate can occur when dissecting the tonsil or with overzealous cautery. Likewise burns to the lip or other mucosal surfaces may result from exposure to the hot end of one of the electrocautery instruments. Injury to the Eustachian tube in the nasopharynx can occur when

Table 10 Uncommon complications of tonsil and adenoid surgery.

Operative complications
Trauma to teeth
Trauma to uvula of Eustachian tube
Burns from electrocautery
Iatrogenic hyponatremia
Post-obstructive pulmonary edema
Velopharyngeal insufficiency
Grisel's syndrome
Mandibular dislocation
Jugular vein thrombosis
Subcutaneous emphysema
Taste Disturbances

using either a curette or powered instrumentation. Mandibular dislocation may also result from opening the mouth gag too widely. Inadvertent injury to the nerves of the pharynx plexus may cause taste disturbances.

Velopharyngeal insufficiency can result from aggressive removal of adenoid tissue. This complication can be avoided by leaving a small cuff of adenoid tissue along Passavant's ridge where the superior and middle constrictors of the pharynx meet.

Problems with ventilation may occur if the endotracheal tube is not adequately secured. Rarely the patient may clamp his teeth down on the endotracheal tube during emergence from anesthesia, developing post-obstructive pulmonary edema if the tube is completely occluded by the teeth for any length of time. Rarely subcutaneous emphysema can develop due to either aggressive positive pressure ventilation following exposure of the tissue plans in the pharynx during surgery.

Inflammation in the neck related to pharyngeal surgery can lead to several complications. Jugular vein thrombosis, a rare complication of infection in the neck, is an example. Likewise Grisel's syndrome — rotary subluxation of the upper cervical vertebrae — can be seen occasionally as a complication of adenoidectomy. Heat, good pain control and antibiotics often resolve this condition. In rare cases, orthopedic consultation and either a cervical collar or traction may be necessary to overcome this inflammatory complication.

Conclusion

Sleep disordered breathing has surpassed recurrent infection as the major indication to perform a tonsillectomy and adenoidectomy in a child. Improvements in both surgical and anesthetic techniques have led to a decrease in the rate of complications. The goals of future treatment include improved pain management and a decrease in complication rates of bleeding and dehydration.

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