

TITLE: The Modern Tonsillectomy

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History

Aulus Cornelius Celsus, a Roman physician and writer, was the first to describe a surgical removal of the tonsils, and stated "the tonsils are loosened by scraping around them and then torn out" with a finger. At the time, vinegar mouthwash and another medication were used to maintain hemostasis. A hook and knife method was described by Aëtius of Amida on the Tigris in the sixth century. The contributions from Paul of Aegina and Philip Syng Physick added to the techniques available for tonsil removal. Physick used forceps to extirpate the tonsil, which eventually transformed into the tonsil guillotine. In the late 1800s, Mackenzie improved upon the tonsillotome and made its use common for tonsillar surgery. Although all of these previous techniques illustrated various methods of tonsil removal, they do not describe removal of the entire tonsil. In 1906, William Lincoln Ballenger recommended complete removal of the tonsils with a knife while keeping the capsule intact. George Ernest Waugh of England is credited as the first to describe complete tonsil excision using careful dissection in 1909. Samuel Crowe reviewed 1000 tonsillectomies performed from 1911 to 1917. He described using the Crowe-Davis mouth gag and performing careful sharp dissection for tonsillectomy. Hemostasis and pain have always been important principles in performing and managing patients following tonsillectomy.

In the United States, tonsillectomy, along with adenoidectomy, has been among the most frequent surgeries performed from 1900 to present. There was a peak from the 1940s to 1950s, with 1.4 million tonsillectomies done in 1959. This number fell to 500,000 in 1979 and further to 340,000 in 1985. In 1996, 287,000 children underwent tonsillectomy. The indications for surgery for the tonsils and adenoids have changed, contributing to decline in numbers. Chronic infection was the primary surgical indication in the 1950s and 1960s. With the advent of antibiotics, the numbers of recurrent tonsillitis have declined. Today, airway obstruction and obstructive sleep apnea are more common preoperative indications for surgery.

Indications for Tonsillectomy

Paradise, et al. conducted parallel randomized and non-randomized clinical trials for the

efficacy of tonsillectomy in the pediatric population with recurrent episodes of pharyngitis. Their stringent criteria included rate of occurrence, clinical features, treatment and documentation. 7 or more episodes in the previous year, 5 or more episodes in each of the previous 2 years, or 3 or more episodes in each of the previous 3 years met their frequency standards. The clinical features of each of the episodes of pharyngitis included fever, cervical lymphadenopathy, tonsillar or pharyngeal exudates, or a positive β -hemolytic streptococcus test. The treatment of these episodes required the administration of antibiotics. The results of this study indicated that tonsillectomy was efficacious for 2 years, and possibly a third, in reducing the frequency and severity of subsequent episodes of pharyngitis.

The American Academy of Otolaryngology-Head and Neck Surgery *Clinical Indicators Compendium* in 1995 published the following indication guidelines for tonsillectomy:

- a) Patient with 3 or more infections of tonsils and/or adenoids per year despite adequate medical therapy.
- b) Hypertrophy causing dental malocclusion or adversely affecting orofacial growth documented by orthodontist.
- c) Hypertrophy causing upper airway obstruction, severe dysphagia, sleep disorders, or cardiopulmonary complications.
- d) Peritonsillar abscess unresponsive to medical management and drainage documented by surgeon, unless surgery performed during acute stage.
- e) Persistent foul taste or breath due to chronic tonsillitis not responsive to medical therapy.
- f) Chronic or recurrent tonsillitis associated with the streptococcal carrier state and not responding to beta-lactamase-resistant antibiotics.
- g) Unilateral tonsil hypertrophy presumed neoplastic.
- h) Recurrent suppurative or otitis media with effusion. (Adenoidectomy alone. Tonsillectomy added requires one of the indications listed above.)

In 2002, Paradise, et al. published another study also conducted as 2 parallel randomized, controlled trials to evaluate the efficacy of tonsillectomy in moderately affected children. Their surgical criteria were not as stringent, and their results indicated that the incidence of pharyngitis in the surgical groups was significantly lower than the control groups for the 3 ensuing years. However, the number of episodes in the control groups was also low, with a 7.9% incidence of surgery-related complications. They concluded that the current official guidelines were not sufficiently stringent for use in clinical practice.

Innovative Tonsillectomy Techniques

As described earlier in the history of tonsil surgery, there has been an evolution of various techniques to improve upon the postoperative morbidities following tonsillectomy. From tonsil scraping with blunt finger dissection without anesthesia to the use of a plasma field for dissection, there have been great strides in the development of modern tonsillectomy techniques. The use of the harmonic scalpel, microdebrider, coblation, and laser for excision of the tonsils are among the newer techniques used. The thrust of these newer techniques is aimed at reducing

the comorbidities associated with standard monopolar electrocautery for tonsillectomy. Intraoperative and postoperative hemorrhage, pain, advancement to regular diet and activity, and overall cost of these procedures have been analyzed in many studies. The degree of thermal injury and disruption of subcapsular tissues are variables examined in many the newer techniques. Several select studies are presented here.

Intracapsular Tonsillectomy

Koltai, et al. performed a retrospective case series to review the use of intracapsular tonsillectomy using powered instrumentation for managing tonsillar hypertrophy causing sleep disordered breathing in children. A microdebrider set at 1500 rpm in the oscillating mode was used to perform the intracapsular tonsil resection, and a thin rim of lymphoid tissue was left on the capsule. Suction cautery was used for hemostasis. 150 children underwent intracapsular tonsillectomy and 162 children underwent total tonsillectomy. Of statistical significance, the intracapsular tonsillectomy group had lower pain scores at each measured interval in comparison to the total tonsillectomy group. In addition, the intracapsular group also had an earlier return to normal activity and less analgesic use. There was no statistical significance among the groups in the time required to resume a normal diet. This study concluded that if the tonsil capsule was left intact, the underlying pharyngeal musculature is undisturbed and isolated from secretions. This results in a decrease in postoperative pain and recovery time as compared to standard tonsillectomy. As with most retrospective studies, recall bias is a common concern.

In a retrospective review and follow up of 278 patients conducted by Sorin, et al. a 3.9% rate of complication from intracapsular tonsillectomy for tonsillar hypertrophy and obstructive sleep apnea in children was determined. There were a total of 11 complications in 278 patients. Nine patients had tonsillar regrowth with snoring. In addition, one had an immediate self-limited bleeding, and one with delayed bleeding.

Bent, et al. conducted a retrospective study to examine the safety and efficacy of performing intracapsular tonsillectomy in children under 3 years to challenge the paradigm that children under 3 years undergoing tonsillectomy require admission. The results indicated no statistically significant difference in pain, oral intake, or analgesic use in the < 3 years and > 3 years groups. In addition, no children in either group required admission.

Harmonic Scalpel Tonsillectomy

The harmonic scalpel is an ultrasonic dissector coagulator that utilizes ultrasonic vibration to cut and coagulate tissues. The cutting mechanism is possible with the sharp blade with a vibratory frequency of 55.5 kHz over a distance of 89 μm . The coagulation mechanism occurs by transferring mechanical energy to tissues. This breaks hydrogen bonds of proteins and generates heat from tissue friction. The temperature of the harmonic scalpel is lower than electrocautery (50° – 100° C, 150° – 400° C, respectively), and there is less thermal damage to tissues. The harmonic scalpel is an expensive product.

Walker and Syed evaluated 316 children undergoing tonsillectomy in a randomized trial to compare the harmonic scalpel (155) and electrocautery (161). There were no differences observed among the two groups in intraoperative blood loss or postoperative hemorrhage. The

harmonic scalpel group had an earlier return to normal diet and activity. There was no significant difference in the frequency of use of narcotic or nonnarcotic analgesic agents.

Willging, et al. performed a single-blind, randomized prospective study to evaluate postoperative morbidity following the use of the harmonic scalpel versus electrocautery for tonsillectomy. 117 patients were enrolled, with 61 in the harmonic scalpel group and 59 in the electrocautery group. The indications for tonsillectomy included recurrent infection and hypertrophy with airway obstruction. Clinical outcomes measured included intraoperative bleeding, operative time, and postoperative hemorrhage. In addition, postoperative pain, ability to eat and drink and level of activity were evaluated with questionnaires. There was no statistically significant difference in intraoperative blood loss among the groups. Of significance, the intraoperative time for harmonic scalpel tonsillectomy was almost twice that of electrocautery (8 min 42 sec versus 4 min 33 sec, respectively). Although the harmonic scalpel group reported to sleep more soundly on the first three postoperative days, there was no significance in the ability to eat, drink, swallow and pain when speaking among the groups. Of interest, the level of activity in the harmonic scalpel group was significantly lower from surgery to the end of the first postoperative day. Postoperative pain scores tended to be lower in the harmonic scalpel group. The incidence of postoperative bleeding in the harmonic scalpel group was twice that of the electrocautery group, but this value was not statistically significant.

Laser Tonsillectomy

The CO₂ and KTP lasers have been used to perform tonsil surgery. D. Akin, in a series of more than 500 patients, observed less postoperative pain, more rapid healing, less blood loss, and less operative time using the CO₂ laser.

Kothari, et al. conducted a prospective double-blind randomized controlled trial to compare the use of KTP laser tonsillectomy versus cold dissection and snare with bipolar cautery for hemostasis. A total of 151 children under the age of 16 years were enrolled with 72 in the dissection group and 79 in the laser group. Neither the patient nor the nurses were informed of the technique used. The KTP 532 laser was used at a 10 W continuous beam delivered with a 0.6 mm Endostat fiber. The outcomes measured were operative time, operative bleeding, postoperative pain, resuming a diet postoperatively, and admission or readmission rate. The laser group tended to require greater operative time (12 min) versus the dissection group (10 min), though not statistically significant. Of significance, the blood loss in the laser group (20 mL) was lower than the dissection group (95 mL). In addition, the laser group had significantly higher pain scores than the dissection group. The laser group also tended to have greater difficulty tolerating a diet two and three weeks postoperatively. Although the readmission incidence in the laser group was greater than the dissection group (8% and 4%, respectively), this was not statistically significant. This study concluded that the KTP laser provides little benefit over dissection tonsillectomy except to minimize intraoperative bleeding. This study does not take into account the surgical expertise required to perform an uncommon surgery such as laser tonsillectomy. In addition, it can be argued that electrocautery is currently the most frequent technique used for tonsillectomy, yet this was not included in this study.

Coblation

Coblation, or cold ablation, is a technique that utilizes a field of plasma, or ionized sodium molecules, to ablate tissues. Bipolar radiofrequency energy is transferred to sodium ions, creating a thin layer of plasma. This effect is achieved at temperatures from 40° to 85° C, in comparison to electrocautery which can reach above 400° C. The reduction in thermal injury to surrounding tissues offers reduced postoperative pain and morbidity.

Chang performed a prospective randomized double-blinded controlled study comparing intracapsular tonsillectomy using coblation versus traditional subcapsular electrocautery tonsillectomy. 101 children with tonsillar hypertrophy and obstructive sleep apnea or sleep disordered breathing were included in the study. In the experimental group, tonsils were ablated from the surface laterally at the coblate 9 setting down to but not penetrating the capsule. Hemostasis was achieved with the coblate 5 setting. Adenoidectomy was also performed in all but one in the coblation group. The electrocautery group underwent standard tonsillectomy with the 20 W setting. Outcomes measured were pain, analgesics used, presence of nausea/vomiting, diet tolerated, level of activity, number of days that parents were off of work, and complications. The patient and nurse practitioner blinded to the type of tonsillectomy technique used, and the questionnaire was completed on day 1 or 2, day 3 or 4, and day 5 or 6. The operative time and intraoperative blood loss were similar among the groups. There were no complications in either group. The pain scores in the coblation group were significantly lower than the electrocautery group. Also significant was the ability of the coblation group to eat a greater proportion of their daily diet and had higher level of activity than the electrocautery group. The two groups had similar analgesic use.

Two previous studies by Chan and Stoker also examined the use of coblation versus electrocautery tonsillectomy. Stoker claimed to perform blunt dissection to perform tonsillectomy while Chan's study did not penetrate the capsule like the Chang study. Their results also indicated that postoperative morbidity was lower in the coblation group than in the electrocautery group. A criticism of these studies is that they compared an intracapsular technique to a subcapsular technique. By avoiding the tonsillar capsule, the underlying pharyngeal tissue is left undisturbed using coblation while electrocautery causes significant injury to underlying tissue. Perhaps a better study is to compare two intracapsular techniques like coblation and microdebrider assisted tonsillectomy. In addition, these studies do not evaluate the possibility of tonsillar regrowth following coblation.

Liboon, et al. examined the mucosal tissue incisions made by scalpel, CO₂ laser, electrocautery and ablation. The incision made by a scalpel promoted the least histologic damage. However, this does not necessarily equate to least postoperative morbidity. There are many surgical approaches and techniques available, and it is important to continue to search for the best possible method to reduce morbidity.

Adjuvant Therapy

Postoperative pain and nausea are common following tonsillectomy. Adjuvant therapeutic techniques have been used to reduce the postoperative morbidity from tonsillectomy. These include the use of local anesthetic, dexamethasone intraoperatively, and postoperative

antibiotics.

Local Anesthesia

The tonsils are innervated by tonsillar branches of the glossopharyngeal nerve, palatine nerves derived from the maxillary branch of the trigeminal nerve and from lingual branches of the mandibular division of the trigeminal nerve. Infiltration by a local anaesthetic at the upper and lower tonsil pole and the anterior and posterior pillars anaesthetize these branches.

Bupivacaine is an amide-linked local anesthetic with high lipid solubility and protein binding, giving a rapid onset and a prolonged effect of 6–9 h. In a prospective, double-blind, controlled study by Violaris and Tuffin, the application of topical bupivacaine was compared to saline following tonsillectomy. They reported that the side treated with normal saline actually fared better, with less pain, than the side coated with 0.5% bupivacaine. Jebeles et al infiltrated the tonsillar fossae of children with bupivacaine and reported a marked reduction in pain after tonsillectomy even beyond the first week after surgery.

Nordahl, et al. conducted a prospective double-blind randomized clinical trial with three treatment arms to evaluate whether postoperative pain was influenced by injection of bupivacaine prior to tonsillectomy incision. 126 patients were evaluated, age 6 years and older, with exclusion of comorbid conditions including bupivacaine allergy. After randomization, 42 patients were in the saline (9mg/ml) arm, 41 in the saline (9mg/ml) with epinephrine (5µg/ml) arm, and 43 in the bupivacaine (2.5mg/ml) with epinephrine (5µg/ml) arm. About 5 minutes after anesthesia induction, the bilateral peritonsillar fossae were infiltrated with 5ml of study solution and tonsillectomy was performed 5 minutes later. The tonsillectomy technique was not specified but was indicated to be performed in a standardized manner for all cases. Pain measurements, including pain when swallowing, were recorded using a visual analog scale at standardized intervals following the tonsillectomy. The only statistically significant pain score among the groups was with the value of pain when swallowing. In addition no statistical significance was noted in the consumption of analgesics (paracetamol) among the treatment arms. Among patients operated on by an experienced otolaryngologist, those injected with bupivacaine and epinephrine tended to report less pain than patients in the other two treatment groups. In contrast, among patients operated by an ENT surgeon with little experience, patients in the bupivacaine and epinephrine group had the highest pain scores. Overall, this study concluded that bupivacaine injection does not provide a significant improvement in postoperative analgesia following tonsillectomy in an unselected group. Teenagers tended to have less analgesia from bupivacaine, but due to small sample size of age groups, this is not a precise conclusion.

Kountakis conducted a prospective, randomized, blinded and controlled study in Houston, TX, using local infiltration of 10 mL 0.5% bupivacaine solution versus infiltration with 10 mL of normal saline to examine the effectiveness of perioperative local anesthesia in tonsillectomy patients age 18 and older. 34 patients were entered in the study, but only 20 patients completed the questionnaires. After randomization, patients had the selected solutions infiltrated into the uvula, and bilateral anterior and posterior pillars. The technique used was electrocautery with blood loss up to 5ml and no reported complications. The questionnaire was completed daily for 10 days, and included a pain scale, amount of pain medicine taken and oral intake. The bupivacaine group initially fared better with a lower pain rating until about the 4th

postoperative day. On postoperative day 4, the bupivacaine group reported greater pain than the saline group and this continued until the 10th day. Similarly, patients in the bupivacaine group consumed less pain medication initially, but this reversed on the 4th postoperative day and required greater oral analgesics through the 10 days. Oral intake was relatively equal in the two groups for the first two postoperative days, but this again changed by the 3rd day and the saline group had greater oral intake through to the 10th day. Interestingly, there was no statistical significance in pain, pain medicine consumption, and oral intake between the groups.

Dexamethasone

Dexamethasone has been shown to be effective as an antiemetic agent in randomized trials with chemotherapy. Although, the exact mechanism by which dexamethasone exerts its antiemetic effect is unknown. The euphoric effects of steroids have been well documented, and the administration of dexamethasone for a painful surgery such as tonsillectomy seems reasonable. Its biological half-life is 36 – 72 hours.

Steward, et al. conducted a meta-analysis to evaluate the reduction of postoperative emesis, pain, and return to soft or solid diet. A total of eight double-blinded, randomized, controlled studies analyzing dexamethasone in children undergoing tonsillectomy or adenotonsillectomy were included in the meta-analysis. A single dose of intraoperative dexamethasone with dosing 0.15 – 1.0 mg/kg was administered. Sensitivity analyses were performed to statistically evaluate the impact of study exclusion attributed to missing data or varying measuring standards. In the first 24 hours postoperatively, the placebo group was twice as likely to have an episode of emesis than the dexamethasone treated group. The number needed to treat with dexamethasone to avoid one case of postoperative emesis was calculated to be 4.17. Also, the group treated with dexamethasone resumed a diet in the first postoperative day more often than the placebo group. Although the dexamethasone group tended to resume a diet by the third postoperative day more often than the placebo group, this was not statistically significant. Regression analysis determined that a dose of 1mg/kg would have a beneficial antiemetic effect. The analysis of pain was not done due to missing data and varying outcome measures. No adverse events occurred as a result of dexamethasone administration. This study concluded that given the low cost and no reported adverse outcomes with dexamethasone, its administration for tonsillectomy seems reasonable to help prevent emesis in the first 24 hours after surgery and resume a diet in the first postoperative day. By performing sensitivity analyses, this study also addressed the problem of selection bias in the meta-analysis.

Carr, et al. performed a double-blinded randomized controlled trial to evaluate postoperative pain from electrodissection tonsillectomy after single intraoperative dose of dexamethasone in adults. There were no statistically significant differences between the dexamethasone and placebo (saline) groups, but the dexamethasone group tended to report less pain over the initial postoperative days. The dexamethasone group required less analgesic postoperatively, but there were no differences among the groups over 10 days.

Postoperative Antibiotics

Adjuvant postoperative antibiotics are used to decrease the inflammation of pharyngeal tissues following tonsillectomy due to colonization of bacteria. The benefits of antibiotics also

include pain reduction, improving oral intake and possibly decreasing postoperative bleeding. Although, there is controversy to the use of antibiotics due to growing concern for bacterial resistance. Telian et al conducted a randomized controlled trial to evaluate the effect of ampicillin on recovery from tonsillectomy in children. The ampicillin group had significantly fewer fevers, improved oral intake, and required fewer days to normal activity.

Colreavy, et al. examined the use of amoxicillin/clavulanic acid in a randomized controlled trial in children. 78 patients were randomly assigned to either receive antibiotics or not. They compared tonsillar core, surface and postoperative tonsil fossa bacterial colonization profiles in the two groups. Bipolar tonsillectomy was performed in both groups. Their results indicated tonsil core bacteria were *H. influenzae* (64%) 9.5% of which produced β -lactamase, *Step viridans* (55.9%), *S. aureus* (37%) 86% of which produced β -lactamase, and anaerobes (25%). More importantly, the pain scores, days to normal diet, and analgesic use in the group treated with antibiotics were significantly lower. This study concluded that it is logical to treat chronic carriers of β -lactamase producing organisms following tonsillectomy with amoxicillin/clavulanic acid.

O'Reilly, et al. conducted a randomized double-blind controlled prospective trial of the effect antibiotics in adults following tonsillectomy. The antibiotic group received intraoperative and postoperative antibiotics. Patients were questioned at follow-up or sent a questionnaire to assess postoperative bleeding, postoperative pain, and if their PCP was contacted. The technique used varied, but electrocautery was most commonly used. The results of this study indicated that antibiotics had no influence on postoperative pain and bleeding. However, there were significant weaknesses in this study. This study had a high drop out rate, and recall bias.

Current Practice Patterns

In 2004, Krishna, et al. published their results of a 13 question survey mailed to a small percentage of AAO-HNS members to evaluate the practice patterns of otolaryngologists with regard to tonsillectomy. The questionnaire included the technique used most and why, the use of local anesthetic, the use of steroids, and the use of postoperative antibiotics. Sharp dissection was the technique used most frequently among otolaryngologists in practice more than 20 years, while monopolar electrocautery was the technique used most often as a whole and by those in practice between 5-20 years. The reason for the preferred method of tonsillectomy was most commonly decrease in blood loss. The monopolar electrocautery group stated low blood loss as the primary reason for the technique used, while the sharp dissection group cited decreased postoperative pain the primary reason. The use of local anesthetic was split nearly evenly within the study. Although the majority of the respondents stated the use of perioperative steroids, those in practice for more than 20 years were less likely to use steroids. In addition, the reasons stated for the use of steroids were to decrease pain, decreased nausea, and decrease swelling. Most used postoperative antibiotics, and cited decreased pain, decreased inflammation or faster healing as the primary reasons.

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