Harmonic scalpel tonsillectomy versus hot electrocautery and cold dissection: An objective comparison

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Abstract

We conducted a large-scale retrospective study to compare the surgical efficacy, practical utility, safety, and cost-effectiveness of ultrasonic harmonic scalpel tonsillectomy, hot electrocautery, and cold surgical dissection. We based our findings on the length of operating time, complication rates, the length of hospital stay for patients with complications, and relative costs. We then compared our findings with those published in earlier reports, none of which were based on a three-way comparison. Our study population was made up of 316 patients—175 males and 141 females aged 1 to 23 years (mean: 7.3)—who had undergone adenotonsillectomy or tonsillectomy alone at our tertiary care children's hospital between Sept. 1, 2000, and Aug. 31, 2001. The harmonic scalpel was used on 75 patients (23.7%), electrocautery on 109 patients (34.5%), and cold surgical dissection on 132 (41.8%). The mean length of operating time for adenotonsillectomy was 42.4 (n = 70), 43.0 (n = 103), and 49.2 (n = 95) minutes, respectively; the corresponding times for tonsillectomy alone were 23.6 (n = 5), 30.2 (n = 6), and 35.3 (n = 37) minutes. Overall complication rates were 2.7, 5.5, and 6.1%, respectively. Hospital stays for immediate (<24 hr) postoperative bleeding averaged 2.0, 1.0, and 0.7 days, respectively, and stays for dehydration averaged 1.0, 1.3, and 1.5 days. Mean per-patient institutional costs were $460.00, $310.75, and $300.00, respectively. We conclude that harmonic scalpel tonsillectomy is efficacious, practical, safe, and cost-effective, and we recommend that any institution involved with a significant number of pediatric tonsillectomies consider using it.

Introduction

Tonsillectomy has been a known surgical procedure for almost 2,000 years. The first cases were described by Celsus as early as 50 AD.1,2 As recently as the early 20th century, it was believed that tonsillitis was caused by various systemic disorders (e.g., rheumatoid arthritis). Proponents of tonsillectomy also began to use the procedure to treat such conditions as mental retardation and anorexia and to use it simply as a measure to promote good general health.1,3 Perhaps the ultimate in enthusiasm for tonsillectomy and adenoidectomy was manifested by certain communities in Russia, where wholesale surgery was performed on entire populations of school children in public school buildings.4

Today, approximately 259,000 tonsillectomies are performed annually in the United States—one-fourth the number that were performed just 30 years ago.5 The decline of tonsillectomy despite a growing population appears to be attributable to advances in antimicrobial therapy, more definitive criteria for surgical intervention, and a heightened respect on the part of physicians for cost-risk-benefit considerations. Annual expenditures for tonsillectomy average approximately $500 million in the United States.5

The indications for tonsillectomy are numerous. The most widely accepted are recurrent infections; obstructive sleep apnea and/or cor pulmonale as a result of tonsillar hypertrophy; peritonsillar abscess with recurrent tonsillitis; malignancy or suspected malignancy; and tonsillitis that has caused febrile seizures.6 Until the late 1960s, tonsillectomies were performed by cold surgical dissection, where the tonsil is removed from its capsular plane by blunt and sharp dissection. In the 1970s, many surgeons found that hot electrocautery was safe, easy to perform, and offered good control of intraoperative hemorrhage. In fact, monopolar electrocautery dissection is one of the most common procedures in use today.7,8 Innovation and research continue to lead to improvements in the efficacy, safety, and cost of tonsillectomy. One such innovation is the ultrasonic harmonic scalpel, which was introduced in 1993 (Ethicon Endo-Surgery;
Cincinnati) and which is becoming increasingly popular as a tonsillectomy device. Other techniques being studied are bipolar, microbipolar, and laser tonsillectomy.

Prior to its use in otolaryngology, the harmonic scalpel was already widely used by laparoscopic and gynecologic surgeons. It has been shown to be a valuable tool for numerous laparoscopic and open surgical procedures, including cholecystectomy, Nissen fundoplication, bowel resection, and adhesiolysis. The harmonic scalpel uses ultrasound, the unique energy form that allows for both cutting and coagulation at the precise point of impact. The blade of the instrument vibrates at 55,500 cycles per second, which minimizes lateral thermal tissue damage. There is almost no need for instrument changes. The reasons for the increasing popularity of the harmonic scalpel within the otolaryngology community are its purported associations with less postoperative pain and an earlier return to oral intake and regular activities.

In this article, we describe our retrospective comparison of the surgical efficacy, practical utility, safety, and cost-effectiveness of ultrasonic harmonic scalpel tonsillectomy in relation to the time-tested methods of electrocautery and cold surgical dissection. Specifically, we based our findings on the length of operating time, complication rates, the length of hospital stay for patients with complications, and relative costs.

Patients and methods

We performed a retrospective study of 316 patients (175 males and 141 females aged 1 to 23 years [mean: 7.3]) who had undergone adenotonsillectomy (n = 268) or tonsillectomy alone (n = 48) at the Children’s Hospital of Michigan, a tertiary care hospital, between Sept. 1, 2000, and Aug. 31, 2001.

Of the 316 procedures, 75 (23.7%) were performed with the harmonic scalpel (70 adenotonsillectomies and 5 tonsillectomies), 109 (34.5%) by electrocautery (103 adenotonsillectomies and 6 tonsillectomies), and 132 (41.8%) by cold surgical dissection (95 adenotonsillectomies and 37 tonsillectomies). All surgeries were performed by one of three experienced otolaryngologists.

All children 3 years of age or younger remained in the hospital for overnight observation. All other patients were discharged home once they were able to tolerate oral fluid and after they had undergone a physical examination of the tonsillar fossae performed by an otolaryngologist. Any patient who was unable to tolerate a clear liquid or a Popsicle orally was kept for overnight observation and intravenous hydration. Routine postoperative instructions, antibiotics, and narcotic analgesia were provided to all patients.

Results

The conclusions drawn from this study were based on the length of operating time, complication rates, the length of hospital stay, and costs associated with each of the three procedures (table).

Operating time. For the adenotonsillectomies, the mean length of operating time was 42.4 minutes for the 70 harmonic scalpel procedures, 43.0 minutes for the 103 electrocautery procedures, and 49.2 minutes for the 95 cold dissections.

For the tonsillectomies alone, the operating times were 23.6 minutes for the 5 harmonic scalpel procedures, 30.2 minutes for 6 electrocauteries, and 35.3 minutes for the 37 cold dissections.

For the adenotonsillectomies, we were not able to determine precisely how long it took to perform each of the two components of the combined procedure because our institution did not record the specific time when the tonsillectomy ended and the adenoidectomy began.

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<th>Table. Data summary based on 316 adenotonsillectomies and tonsillectomies</th>
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<td>Harmonic scalpel (n = 75)</td>
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<td>Mean operating time, AT* (min)</td>
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*AT = adenotonsillectomy; T = tonsillectomy.
Complications. Complications were seen in 16 patients (5.1%); 8 (2.5%) experienced immediate (<24 hr) postoperative bleeding that required operative intervention, and another 8 required hospital admission to treat dehydration.

Of the 8 patients who experienced bleeding, 1 was in the harmonic scalpel group, 3 were in the electrocautery group, and 4 were in the cold dissection group. The corresponding figures for the patients who experienced dehydration were also 1, 3, and 4. Therefore, the overall complication rates in the three groups were 2.7, 5.5, and 6.1%, respectively.

Hospital stay. Among the 8 patients who experienced postoperative bleeding, the mean length of stay was 2.0 days in the harmonic scalpel group, 1.0 days in the electrocautery group, and 0.7 days in the surgical dissection group. Among those who experienced dehydration, the corresponding figures were 1.0, 1.3, and 1.5 days.

Cost. Based on factors such as operating room time and the use of disposable and nondisposable equipment, the mean institutional per-patient cost of surgery was $460.00 for the harmonic scalpel procedure, $310.75 for electrocautery, and $300.00 for surgical dissection.

Discussion

Harmonic scalpel dissection is a relatively new approach to tonsillectomy, and to our knowledge, no other study has been conducted to objectively compare it with both hot electrocautery and cold surgical dissection in terms of operating time, complications, hospital stay, and cost.

In view of the unique properties of the harmonic scalpel—namely, its ability to cut and coagulate with great precision, which results in minimal lateral thermal tissue damage, and the fact that it provides better visibility of the surgical field—some authors have contended that harmonic scalpel tonsillectomy results in less postoperative pain and fewer complications. For example, Walker and Syed performed a large-scale study (which also included 316 patients) to compare harmonic scalpel tonsillectomy with electrocautery tonsillectomy. They focused primarily on postoperative pain and return to regular diet and activity, but they also reported that the rates of delayed (>24 hr) postoperative bleeding and dehydration among the harmonic scalpel patients were lower than those among the electrocautery patients. Besides the fact that their study did not include a comparison of cold dissection, they did not evaluate other objective parameters necessary to fully assess the use of the harmonic scalpel. In another study, Akural et al compared harmonic scalpel tonsillectomy with blunt dissection tonsillectomy in terms of subjective postoperative pain in 32 patients. They found that the harmonic scalpel was associated with less short-term pain but more long-term pain. Again, their small study was not based on any objective criteria and, of course, they did not include an assessment of electrocautery. Each of the three common tonsillectomy techniques in our study was performed on a significant proportion of the 316 patients. All surgeries were performed by experienced pediatric otolaryngologists.

Operating time. Only 48 of the 316 patients (15.2%) in our study had undergone tonsillectomy alone. Nevertheless, a consistent pattern emerged when we compared the operating times for tonsillectomy alone with those for adenotonsillectomy. In both cases, operating times were shortest for the harmonic scalpel procedure and longest for cold dissection. Even with our relative degree of inexperience with the harmonic scalpel, we were still able to perform surgery more quickly with it than we were with the more established modalities. As we gain more experience with the harmonic scalpel, we expect to become even faster. The benefits of more rapid surgery, of course, include a reduction in the risk of the patient’s exposure to surgery and anesthesia, more efficient use of surgical time, and a reduction in variable costs.

Complications. Because complications occurred in only 16 patients, we are unable to attach any statistical significance to the differences among the three procedures. Both the individual and combined complication rates among the 75 harmonic scalpel patients were lower than the rates seen with electrocautery and surgical dissection. It is interesting that the highest complication rates were seen with surgical dissection, the oldest of the three techniques and one that is still widely used (in fact, in our study, this procedure was used on 132 of the 316 patients [41.8%]). This was so despite the fact that the three surgeons had more experience with cold dissection than they did with either of the other two modalities.

Hospital stay. Again, in light of the fact that the number of patients who required hospital admission was so small (n = 16), we are unable to arrive at any statistically significant conclusions with respect to length of stay. Even so, in the harmonic scalpel group, we can report that the length of stay for the patient who experienced bleeding (2 days) and the patient who experienced dehydration (1 day) did not exceed the acceptable norms usually associated with all other tonsillectomy techniques.

Cost. The financial implications of using the harmonic scalpel for tonsillectomy would vary from institution to institution, but this modality is clearly more expensive than either electrocautery or cold dissection from strictly an operating room standpoint. The major fixed cost involves the purchase of the ultrasonic generator itself; the primary variable cost would depend on the number of disposable handpieces that each institution purchases. At our institution, the generator was provided by the manufacturer at no cost to us; our only additional expense was incurred by purchasing the handpieces.

However, we must also consider the tangential savings that can be realized by using the harmonic scalpel in terms of lower complication rates. The management of compli-
cations in a given patient can add thousands of dollars to the cost of the original surgery. Additional costs are also incurred by a patient’s family in terms of time lost from work and other expenses. With this in mind, we conclude that the use of the harmonic scalpel is as cost-effective as the time-tested methods. As the use of the harmonic scalpel becomes more commonplace, we expect that the cost of the instrument itself will decrease, which will further enhance its cost-effectiveness.

Other factors. Even though our study did not include any evaluation of postoperative pain or return to normal activity, two other studies did demonstrate an advantage in favor of harmonic scalpel tonsillectomy. 12,13

In conclusion, our experience with the harmonic scalpel thus far has been positive, and we will continue to use it for tonsillectomy. We recommend that any institution involved with a significant number of pediatric tonsillectomies consider using it, as well.

References