

Does the use of radiofrequency ultrasonic dissector in tonsillectomy have a beneficial effect over the use of laser?

Mustafa T. Adnan, MBBCH, FACHARZT, Moataz M. Abdel-Fattah, MBBCH, PhD, Naeem K. Makhdoom, MBBCH, FACHARZT, Atef A. El-Khouly, MBBCH, FRCS.

ABSTRACT

الأهداف: مقارنة المرضى أثناء وبعد إجراء عملية استئصال اللوزتين بين طريقة الذبذبات الإشعاعية الفوق صوتية (US) وباستخدام الليزر .

الطريقة: تم إحصاء وتسجيل جميع المرضى الذي تم إجراء عملية استئصال اللوزتين لهم بمستشفى الهدى للقوات المسلحة (الطائف) ومستشفى حراء (المدينة المنورة) - المملكة العربية السعودية، خلال الفترة مابين يناير 2000م وحتى ديسمبر 2005م. تم استخدام طريقة الذبذبات الإشعاعية الفوق صوتية US على جانب، وطريقة الليزر على الجانب الآخر لنفس المريض. سُجِلت جميع البيانات الخاصة بالمرضى من فقدان الدم أثناء وبعد إجراء العملية الجراحية، الفترة الزمنية لإجراء العملية الجراحية، بالإضافة إلى إحساس وشعور المرضى بكمية الآلام بعد إتمام العملية الجراحية.

النتائج: تم إحصاء وتسجيل (528) مريضاً لهذه الدراسة وأُتضح الآتي: متوسط طول الفترة الزمنية لإجراء العملية كان أقصر باستخدام طريقة الذبذبات الإشعاعية الفوق صوتية US بالمقارنة باستخدام طريقة الليزر $p < 0.01$ ، متوسط كمية الدم المفقود أثناء إجراء العملية باستخدام طريقة الذبذبات الإشعاعية الفوق صوتية US كان أقل بالمقارنة باستخدام طريقة الليزر $p < 0.001$ ، متوسط الشعور والإحساس بالألم بعد إجراء العملية بطريقة الذبذبات الإشعاعية الفوق صوتية US كان أقل $p < 0.001$ ، بالمقارنة باستخدام طريقة الليزر. لم يكن هناك أية فروق بالنسبة لمتوسط ومعدل نسبة النزيف بعد إجراء العملية تم تحديده بين المجموعات المختبرة.

خاتمة: إن استخدام طريقة الذبذبات الإشعاعية الفوق صوتية US في إجراء عملية استئصال اللوزتين كشفت عن تأثير مفيد أثناء العملية في النواحي التالية: فقدان الدم، الفترة الزمنية لإجراء العملية، الإحساس والشعور بالألم بعد إجراء العملية، عنها باستخدام طريقة الليزر .

Objectives: To compare the intra- and post-operative morbidities on the use of radiofrequency ultrasonic dissector (US) with the use of laser during tonsillectomy in the same patients.

Methods: A randomized comparative study was implemented where all patients underwent tonsillectomy at Al-Hada Armed Forces Hospital, Taif, and Aouhod Hospital, Al-Madinah, Kingdom of Saudi Arabia during the period January 2000 to December 2005 were recruited for the study. Radiofrequency US was used in one side, and laser was used in the other side of the same patient. Intra- and post-operative blood losses, and duration of the operation, in addition to postoperative pain score were recorded.

Results: Five hundred and twenty-eight patients were recruited for the study. The mean operation duration was significantly shorter in the US group as compared to the laser group ($p < 0.01$). Intraoperative blood loss was significantly lesser in the US group ($p < 0.001$). Post-operative pain score was significantly lower among US subjects ($p < 0.001$). No significant difference in postoperative hemorrhage was detected between the compared groups.

Conclusion: The use of US in tonsillectomy showed a beneficial effect on intraoperative blood loss, duration of the operation, as well as, postoperative pain over the use of laser.

Saudi Med J 2008; Vol. 29 (12): 1775-1778

From the Departments of Ear, Nose & Throat (Adnan, El-Khouly), the Preventive Medicine (Research Unit) (Abdel-Fattah), Al-Hada Armed Forces Hospital, Taif, and the Department of Ear, Nose & Throat (Makhdoom), Aouhod Hospital, Al-Madinah Al-Monawarah, Kingdom of Saudi Arabia.

Received 31st May 2008. Accepted 9th November 2008.

Address correspondence and reprint request to: Professor Moataz Abdel-Fattah, Head and Consultant of Preventive Medicine Department, Al-Hada Armed Forces Hospital, Taif, Kingdom of Saudi Arabia. Tel. +966 508741383. Fax: +966 (2) 7541238. E-mail: mezo106@yahoo.com / mezo106@gmail.com

Tonsillectomy is one of the most common surgical procedures in the otolaryngology and throughout the world, for children and many adults.¹ Although tonsillectomy procedures are common, like any surgical procedure, there are postoperative complaints

and complications.² The use of sharp dissection and electrocautery (EC) in tonsillectomy often results in postoperative pain, hemorrhage, otalgia, dehydration, sore throat, and fever.^{3,4} Poor postoperative oral intakes due to pain or sore throat, can lead to dehydration, fever, referred otalgia, and inflammation. These complications can be severe enough to require hospitalization.^{1,2} Postoperative hemorrhage is less common, but can cause serious complications; it can range from minor bleeding, requiring only reassurance to parents and children, to severe bleeding that requires surgical intervention.⁵ The choice of surgical tools and techniques, and their effect on the outcome and morbidity of tonsillectomy have been a standard issue. Many investigators have compared various techniques and tools. Studies have evaluated laser dissection with ultrasonic dissection in varying numbers and ages of subjects. Some investigators conclude that laser treated patients have a higher pain rate and longer recovery time, compared with those treated with ultrasonic dissection.⁶⁻⁹ A new surgical tool, the ultrasonic dissector (US), an ultrasonic dissector coagulator, uses ultrasonic technology to cut, and coagulate tissues. Incisions created with US had less bleeding and incise tissue with less applied pressure than the conventional scalpel, with a minimal delay in healing, warranting its use in clinical applications. A canine tonsillectomy model was developed, to determine outcome differences between US and laser.^{10,11} Recently, US has been used clinically in tonsillectomies. Initial results have been favorable, showing postoperative pain was low, blood loss was minimal, operative time was short, and histopathologic evaluation was not impaired.¹²⁻¹⁴ This study aimed at comparing the intra- and post-operative morbidities of the use of US for the right tonsil versus laser in the left tonsillectomies in the same patients during tonsillectomy.

Methods. All pediatric and adolescent patients presented with recurrent tonsillar infection, adenotonsillar hypertrophy with airway obstruction, or tonsillar asymmetry were recruited for the study. The study was conducted during the period January 2000 to December 2005 at the Ear, Nose, and Throat clinics of both of the Al-Hada Armed Forces Hospital (351 beds), Taif, and Ouhod Hospital (200 beds), Al-Madinah Al-Monawarah, Kingdom of Saudi Arabia. The research and ethics boards of each hospital approved the protocol. Informed consent was obtained from all participants before the study enrollment. Subjects were excluded from the study participation due to malignancy (confirmed by post-operative histopathology), or acute peritonsillar abscess, immunocompromise, HIV infection, or acute

mononucleosis. Subjects were also excluded if they were receiving chemotherapy, using steroids chronically, or pregnant, or lactating. Each subject had a preoperative examination during the screening visit to document concomitant medications, demographic information, and medical and surgical history, and to receive a complete physical examination. Once the subject was enrolled, a subject number determined the use of US for the right tonsil, and laser for left tonsillectomy in the same patients, and was known to the surgeon.

Surgical technique. All subjects were operated on under general anesthesia. Both the US and the laser techniques were performed by grasping the tonsil for traction, and incising the anterior tonsillar pillar to expose the tonsillar capsule. The superior pole was mobilized, separating the tonsil from deeper tissue in the relatively avascular plane adjacent to the tonsillar capsule, and continuing to dissect the tonsil from superior to inferior pole. Ultrasonic scalpel setting used was level 3. The laser settings that were used were 10 watts to dissect, and 15 watts to cauterize. There are 2 cutting mechanisms. The most important cutting mechanism is the blunt blade vibrating. The other cutting mechanism results from the rapid forward- and -backward motion of the tip in contact with the tissue, which causes the generation of increasing and decreasing internal tissue pressures, leading to cavitation fragmentation.¹⁵ The coagulation mechanism of the US happens, via the transfer of mechanical energy to the tissues, breaking tertiary hydrogen bonds to denature protein, and via the generation of heat from internal tissue friction from the high-frequency vibration of the tissue.¹⁵ Unlike lasers that cut, and coagulate when the temperature of cells increase until the gas pressure explodes the cells typically, between 150°C and 400°C, US temperature of friction is much lower at 50-100°C. Scalpel incisions had the least tissue injury and fastest healing, and the US produced much less tissue injury and faster healing than the EC and the CO₂ laser.^{15,16} Any bleeding sites were cauterized with suction cautery. Intraoperative blood loss was recorded, as well as time to perform the tonsillectomy (cut-to-finish). The time of these procedures (namely adenoidectomy, ventilation tubes) was not reflected in the reported tonsillectomy time. Patients were discharged, when they recovered from anesthesia in the case of outpatient surgery. When overnight observation was required, patients were discharged 24 hours postoperatively. Pain medication administration was left to the discretion of the family. For both techniques, the following clinical outcomes were evaluated; intraoperative blood loss, operation time, and hemorrhage. Postoperative pain and otalgia were also evaluated to determine, which

of these tools were most effective in minimizing postoperative morbidities. On postoperative days 1-7, and on day 14, the subjects (or their parent/guardian), aged 5-12 years, evaluated postoperative pain using the Wong-Baker faces pain rating scale. It goes from zero to 5; 0 = no hurt; 1 = hurts a little bit; 2 = hurts a little more; 3 = hurts even more; 4 = hurts a whole lot; 5 = hurts worst.¹⁷ A questionnaire for rating pain was adopted for those aged >12 years. This scale needs to be completed on awakening each morning, and before the administration of pain medication. On postoperative day 14, the surgeon examined the subjects before leaving the study. All adverse events were clarified at this visit. In this study, postoperative hemorrhage was defined as the presence of any amount of blood.

Statistical analysis. All statistical analyses were carried out using a statistical program (SPSS 13.0; SPSS Inc., Chicago, IL, USA). The Chi-square test of independence, and Fisher's exact test were used to analyze the differences between the 2 groups for the frequency data. The differences between the 2 groups concerning continuous variables, such as the amount of bleeding and the pain scores, were analyzed by the Mann-Whitney U-test, and the 2-tailed student's t-test, as appropriate. A *p*-value of <0.05 was considered to be statistically significant.

Results. Five hundred and twenty-eight patients, ranging in age from 5-25 years with an average of 13.1±6.57, were recruited for the study. The males represented 57.8% (n=305) of the studied patients, and the females were 42.2% (n=223). As shown in Table 1, there was statistically significant difference between the 2 tonsils regarding intraoperative blood loss (*p*=0.0008). It was >3 ml in 19.7% among the tonsils treated by US, as compared to 30.1% among tonsils treated with laser. Duration of the operation was 3 minutes and 13 seconds (95% confidence interval, range between 4 minutes and 59 seconds - 5 minutes and 14 seconds) for US treated tonsils, as opposed to 4 minutes and 33 seconds (95% confidence interval, range between 4 minutes and 9 seconds - 6 minutes and 12 seconds) for those treated with laser. The difference was statistically significant (*p*=0.003). No significant difference in postoperative hemorrhage was detected between compared groups. As regard with the pain rating scale, the laser group were more likely than US to experience high pain score. Among US group, 31.5% had experienced either a little bit pain, and 4.4% showed worst pain, as compared to the laser group 25.4% for no pain, and 7.7% for little and worst pain. Overall, the mean rank score of the laser group was significantly higher than in the US group (*p*=0.0009) as shown in Table 2.

Discussion. The ideal tonsillectomy should be fast, painless, bloodless, and associated with rapid recovery from surgery.⁹ There are many proven methods for tonsillectomy such as cold knife dissection, laser, guillotine, snare with suture, suction cautery, hot knife dissection, microdissection, and bipolar and unipolar cautery.⁵ None of these methods, however, have been able to provide the patient with all aspects of the ideal tonsillectomy. The ability to cauterize and seal vessels during the surgical procedure using devices, such as US or laser, appears to enhance the control of bleeding, compared with the cold dissection technique.⁶ Intraoperative blood loss is especially important in pediatric patients due to their small blood volume.³ Unlike other studies of cold dissection in which subjects could lose 50 mL of blood during surgery, the use of US and laser in this study resulted in minimal blood loss; all except 3 subjects lost 1 mL. Given the hemostatic

Table 1 - Comparison of radiofrequency ultrasonic group with laser group according to the duration of the operation, intra- and post-operative blood loss.

Variables	US group N=528	Laser group N=528	P-value
<i>Mean duration of the operation (95% CI)</i>			
minutes	3 (4-5)	4 (4-6)	0.003
seconds	13 (59-14)	33 (9-12)	
<i>Intra-operative blood loss (%)</i>			
None	237 (44.9)	158 (29.9)	0.0008
1-3 ml	187 (35.4)	211 40	
>3 ml	104 19.7	159 30.1	
<i>Post-operative blood loss (%)</i>			
None	526 99.6	525 96.4	>0.05
Primary	1 0.2	1 0.2	
Secondary	1 0.2	2 0.4	
US - ultrasonic dissector, CI - confidence interval			

Table 2 - Comparison of radiofrequency ultrasonic group with laser group according to Wong-Baker faces pain rating scale.

Wong-Baker faces pain rating scale	US group N=528 n (%)	Laser group N=528 n (%)
0 = no hurt	60 (11.4)	35 (6.6)
1 = hurts a little bit	106 (20.1)	99 (18.8)
2 = hurts a little more	192 (36.4)	128 (24.2)
3 = hurts even more	110 (20.7)	144 (27.3)
4 = hurts a whole little	37 (7.0)	82 (15.5)
5 = hurts worst	23 (4.4)	40 (7.6)
Median (range)	2.0 (0-5)	3.0 (0-5)
Mean (SD)	2.05 (1.24)	2.49 (1.34)
Mean rank score	478.49	578.51
Z-value of Mann-Whitney test = 5.471, <i>p</i> =0.0009		

advantages, as well as other clinical advantages, the use of US could benefit patients who cannot afford blood loss (namely children, persons with anemia).

Postoperative hemorrhage can be subdivided into primary and secondary bleeding. Primary hemorrhage occurs within 24 hours of surgery.³ Secondary hemorrhage occurs 24 hours after surgery, sometimes as late as 14 days after surgery, and is associated with the normal separation of scar from the tonsillar fossa.⁸ Recent prevalence of postoperative hemorrhage, both primary and secondary, has been reported from 0.2-8% depending on the technique used, the definition of hemorrhage, and patient population age.^{4,5,8,18,19} There is a certain amount of pain that is to be expected after a tonsillectomy due to the nature of the surgical procedure. The tonsillar capsule is removed, exposing the superior pharyngeal constrictor muscle. Ultrasonic scalpel provides homeostasis equivalent to that achieved in laser, and appears to reduce pain postoperatively. In the current study, a comparison of laser and US in 528 patients serving as their own controls, found that the US-treated side had a significant decrease in the severity of pharyngeal pain after surgery. The same was reported by others, who compared it with blunt dissection.^{20,21} In a study carried by Weimert et al,⁸ during the first week, the majority of the subjects reported less pharyngeal pain at the right side than the left side tonsil. At 2 weeks after surgery, 50% thought that laser was more painful. In another study, the researchers found that, between postoperative days 4 and 7, the majority of subjects thought that laser was more painful.⁹ Almost both studies did find, that the amount of blood loss was less in US treated patients.

Tonsillectomy remains an uncomfortable procedure for those undergoing the procedure. Children >5 years, may especially benefit from the use of HS in tonsillectomies. Pediatric patients of this age are not usually given narcotics for pain control. The use of a technique that potentially reduces pain could prove to be beneficial for such young patients. Techniques that provide safe surgical outcomes, with the least postoperative discomfort for patients should be used.

For proper randomization, it should have been that each patient was randomized to have either the right or left tonsil removed by laser or ultrasound. However, in our study, each side was carried out in the same way in every case. Also, children are not separated, and analyzed separately from adults.

In conclusion, by using ultrasonic coagulation, minimal lateral thermal damage occurs, because US cuts at a lower temperature than laser does. The degree of thermal injury to the tonsil bed was lower, as well as a decrease in tissue trauma may account for the improvement in ability to sleep, and improved pain scores in the US group.

References

1. Toma AG, Blanshard J, Eynon-Lewis N, Bridger MW. Post-tonsillectomy pain: the first ten days. *J Laryngol Otol* 1995; 109: 963-964.
2. Warnock FF, Lander J. Pain progression, intensity and outcomes following tonsillectomy. *Pain* 1998; 75: 37-45.
3. Randall DA, Hoffer ME. Complications of tonsillectomy and adenoidectomy. *Otolaryngol Head Neck Surg* 1998; 118: 61-68.
4. Colclasure JB, Graham SS. Complications of outpatient tonsillectomy and adenoidectomy: a review of 3,340 cases. *Ear Nose Throat J* 1990; 69: 155-160.
5. Blomgren K, Qvarnberg YH, Valtonen HJ. A prospective study on pros and cons of electrodissection tonsillectomy. *Laryngoscope* 2001; 111: 478-482.
6. Wexler DB. Recovery after tonsillectomy: electrodissection vs. sharp dissection techniques. *Otolaryngol Head Neck Surg* 1996; 114: 576-581.
7. Linden BE, Gross CW, Long TE, Lazar RH. Morbidity in pediatric tonsillectomy. *Laryngoscope* 1990; 100 (2 Pt 1): 120-124.
8. Weimert TA, Babyak JW, Richter HJ. Electrodissection tonsillectomy. *Arch Otolaryngol Head Neck Surg* 1990; 116: 186-188.
9. Leach J, Manning S, Schaefer S. Comparison of two methods of tonsillectomy. *Laryngoscope* 1993; 103: 619-622.
10. Hambley R, Hebda PA, Abell E, Cohen BA, Jegasothy BV. Wound healing of skin incisions produced by ultrasonically vibrating knife, scalpel, electrosurgery, and carbon dioxide laser. *J Dermatol Surg Oncol* 1988; 14: 1213-1217.
11. Armstrong DN, Ambroze WL, Schertzer ME, Orangio GR. Harmonic Scalpel vs. electrocautery hemorrhoidectomy: a prospective evaluation. *Dis Colon Rectum* 2001; 44: 558-564.
12. Sood S, Corbridge R, Powles J, Bates G, Newbegin CJ. Effectiveness of the ultrasonic harmonic scalpel for tonsillectomy. *Ear Nose Throat J* 2001; 80: 514-516.
13. Metternich FU, Sagowski C, Wenzel S, Jäkel K. [Tonsillectomy with the ultrasound activated scalpel. Initial results of technique with Ultracision Harmonic Scalpel] *HNO* 2001; 49: 465-470. German.
14. Shinhar S, Scotch BM, Belenky W, Madgy D, Hauptert M. Harmonic scalpel tonsillectomy versus hot electrocautery and cold dissection: an objective comparison. *Ear Nose Throat J* 2004; 83: 712-715.
15. Amaral JF. Ultrasonic dissection. *Endosc Surg Allied Technol* 1994; 2: 181-185.
16. Amaral JF. The experimental development of an ultrasonically activated scalpel for laparoscopic use. *Surg Laparosc Endosc* 1994; 4: 92-99.
17. Wong DL, Baker CM. Pain in children: comparison of assessment scales. *Pediatr Nurs* 1988; 14: 9-17.
18. Coelho Júnior RG, Brandão FH, Carvalho MM, Aquino EP, Hereira SH, Eiras B. Profile of Patients Submitted to Adenoidectomy, Tonsillectomy and Adenoidectomy with Tonsillectomy in the UNISA. *Int Arch Otorhinolaryngol* 2008; 12: 189-193.
19. Handler SD, Miller L, Richmond KH, Baranak CC. Post-tonsillectomy hemorrhage: incidence, prevention and management. *Laryngoscope* 1986; 96: 1243-1247.
20. Willging JP, Wiatrak BJ. Harmonic scalpel tonsillectomy in children: a randomized prospective study. *Otolaryngol Head Neck Surg* 2003; 128: 318-325.
21. Akural EI, Koivunen PT, Teppo H, Alahuhta SM, Löppönen HJ. Post-tonsillectomy pain: a prospective, randomised and double-blinded study to compare an ultrasonically activated scalpel technique with the blunt dissection technique. *Anaesthesia* 2001; 56: 1045-1050.