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ORIGINAL RESEARCH

Thermal welding versus bipolar tonsillectomy: A comparative study

George T. Karatzias, MD, Vassilios A. Lachanas, MD, and **Vassilios G. Sandris, MD, PhD,** Larissa, Greece

OBJECTIVE: To compare thermal welding tonsillectomy (TWT) with bipolar electrocautery tonsillectomy (BET) procedure.

STUDY DESIGN AND SETTING: A prospective randomized study was conducted on 150 consecutive adult patients undergoing tonsillectomy. Indications included chronic tonsillitis and obstructive sleep apnea syndrome. Exclusion criteria included peritonsillar abscess history, bleeding disorders, and any other procedure together with tonsillectomy. Patients were randomly assigned to TWT or BET groups. Intraoperative bleeding, operative time, postoperative pain, complication rates, and return to normal diet were evaluated.

RESULTS: In the TWT group there was no measurable intraoperative bleeding, while mean bleeding for BET group was 16 mL. No significant difference regarding mean operative time was noticed. Mean postoperative pain score and mean time for return to normal diet were significantly lower in the TWT group. Primary hemorrhage occurred in 1 subject of the BET group. Secondary postoperative hemorrhage was noticed in 1 subject of the TWT group and 3 subjects of the BET group.

CONCLUSION: Thermal welding tonsillectomy procedure provides sufficient hemostasis, lower postoperative pain, and quick return to normal diet.

EBM rating: A-1b

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Tonsillectomy, one of the most frequently performed otolaryngologic surgical procedures, was first described by Celsus in the first century BC. Since then many techniques have evolved, including blunt dissection, guillotine excision, electrocautery, cryosurgery, ultrasonic removal, coblation, laser tonsillectomy, ligasure tonsillectomy, and monopolar and bipolar diathermy dissection.[1-3]

The Thermal Welding System (TWS; Starion Instruments, Saratoga, CA) is a new surgical device for simultaneous tissue sealing and dividing. It consists of a power supply unit (Fig 1A), cautery forceps, and a footswitch. TWS uses a heating element at the tip of the instrument combined with pressure to denature the protein molecules within the tissue. Tissue is squeezed between insulated jaws as focused heat is applied to the local region. The protein molecules in the tissue are denatured and fused to one another, forming a tight seal. More highly focused heat is applied in the center of the tissue within the jaws of the instrument, thereby minimizing any effect on nearby structures.[4,5] The TWS has been used in tonsillectomy procedures, providing sufficient hemostasis, while postoperative pain seemed to be minimal.[5]

In this study thermal welding tonsillectomy (TWT) was compared to bipolar electrocautery tonsillectomy (BET), with special regard to intraoperative bleeding, operative time, postoperative pain, return to normal diet time, and complications.

METHODS

A prospective study was conducted in our department on 150 consecutive adult patients undergoing tonsillectomy. All adult patients presenting for tonsillectomy with the indications of chronic tonsillitis or obstructive sleep apnea syndrome were invited to participate in the study. Exclusion criteria included peritonsillar abscess history, bleeding disorders, and adenoidectomy, or any other procedure together with tonsillectomy. For those patients agreeing to participate in the study, informed consent was obtained. All operations were performed by the two senior surgeons (G.K., V.S.) under general anesthesia. Patients were randomly assigned to either the TWT or the BET group.

From the Department of Otolaryngology, General Hospital of Larissa.

Reprint requests: George T. Karatzias, MD, Consultant, Spurou Loui & Alikis Vougiouklaki STR, Building A, 41335 Larissa, Greece.

E-mail address: vlachanas@hotmail.com.

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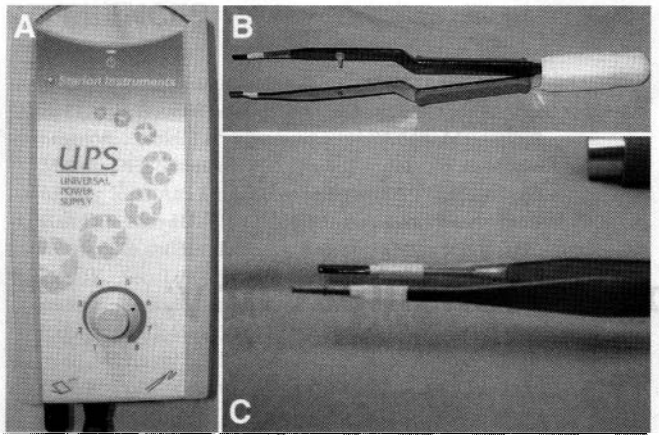

Figure 1 (**A**) The power supply unit of the Thermal Welding System. (**B**) The Bayonet UltraSlim Forceps. (**C**) The tip of the Bayonet UltraSlim Forceps. The active part of the instrument is comprised of a nichrome heating element with a thermally insulating backing.

In the TWT group, among the available TWS power supply unit handpieces, the Bayonet UltraSlim Forceps (110-005D) were selected (Fig 1B), which was used both as hemostatic and dissection tool. Each tonsil was grasped and retracted towards the midline, while no mucosal incision was performed. Anterior pillar mucosa was coagulated with the Bayonet UltraSlim forceps using the "1" setting of the power supply unit, and divided afterwards with the same forceps, using the "8" setting of the power supply unit. In the same manner, dissection of the tonsil from surrounding tissues was performed. Inferior pole was coagulated and divided with the same forceps, and the tonsil specimen was removed. Hemostasis was performed with the UltraSlim forceps, using the "1" setting of the power supply unit.

In the BET group, Bayonet bipolar forceps and a Karl Storz bipolar coagulator (set at 40 W) were used. Anterior pillar mucosa was dissected first, continuing downwards toward the inferior pole. The inferior pole was coagulated, and the tonsil specimen was completely removed. Any further hemostasis of the tonsillar fossa was secured with the bipolar forceps.

Intraoperative blood loss was estimated by measuring the amount in the suction bottle as well as by weighing the cottonoid pledgets before and after the procedure. Operation time, defined as the time for tonsils dissection time with hemostasis when necessary, was recorded at the end of the procedure.

All patients were discharged the day after surgery. The same analgetic regime was used in all patients (1000 mg paracetamol per os every 8 hours until the 2nd postoperative day). Patients were interviewed by phone on postoperative days 1, 3, 5, 7, 10, and 14. On all days contacted, the patients were asked about postoperative pain using an analog scale (range, 0-10, 0 = no pain, 10 = intolerable pain), as well as for returning to normal diet time. A return to normal diet time defined the time within which the patient postoperatively returned to diet without pain sensation during solid food intake. The patients as well as the investigator were blinded to the tonsillectomy technique.

All patients' data, including intraoperative blood loss, operative time, postoperative pain, return to normal diet time, and postoperative complications, were recorded in a database. Statistical analysis was performed using the SPSS 12.0 Base and Advanced Models software (SPSS, Inc., Chicago, IL). The research protocol was approved by the General Hospital of Larissa review board.

RESULTS

Our series consisted of 150 patients, 88 male and 62 female (ratio: 1.42/1). Patients' age ranged from 17 to 56 years (mean 26.8 years). The TWT and BET groups consisted of 81 (45 male and 36 female; ratio: 1.25/1) and 69 (36 male and 33 female; ratio: 1.09/1) subjects respectively. No patient was lost to follow-up.

Intraoperative Bleeding

In the TWT there was no measurable bleeding during surgery in any of the cases but one, where a 5-mL blood loss was noticed due to unilateral hemorrhage from the tonsillar artery (inferior pole area). In this patient monopolar electrocautery was used. Mean intraoperative bleeding for BET group was 16 mL (range, 0-45 mL).

Operative Time

The mean operative time was 22.67 ± 0.38 (mean ± SEM) minutes (range 20-28 minutes) for the TWT group, and 22.23 ± 0.20 (mean ± SEM) minutes (range 19-24 minutes) for the BET group. This difference was not significant ($P > 0.5$) (Table 1).

Table 1
Mean operative time, mean return to normal diet time, primary and secondary postoperative hemorrhage of thermal welding tonsillectomy (TWT), and bipolar electrocautery tonsillectomy (BET) groups

	TWT group (n = 81)	BET group (n = 69)
Operative time ± SEM	22.67 ± 0.38	22.23 ± 0.20
Return to normal diet time ± SEM	8.44 ± 0.12	12.01 ± 0.30
Primary postoperative hemorrhage (n)	0	1 (1.4%)
Secondary postoperative hemorrhage (n)	1 (1.2%)	3 (4.3%)

Table 2
Mean pain scores for postoperative days 1, 3, 5, 7, 10, and 14 and the overall mean pain score of thermal welding tonsillectomy (TWT) and bipolar electrocautery tonsillectomy (BET) groups

	Mean pain score ± SEM	
	TWT group (n = 81)	BET group (n = 69)
1st postoperative day	8.86 ± 0.15	9.54 ± 0.07
3rd postoperative day	8.26 ± 0.16	9.26 ± 0.09
5th postoperative day	7.90 ± 0.19	9.12 ± 0.12
7th postoperative day	6.65 ± 0.23	7.54 ± 0.18
10th postoperative day	2.20 ± 0.15	4.03 ± 0.19
14th postoperative day	1.04 ± 0.09	2.51 ± 0.26
Overall mean pain score	5.82 ± 0.16	7.00 ± 0.15

Postoperative Pain

The mean pain scores of TWT and BET groups for postoperative days 1, 3, 5, 7, 10, and 14, as well as overall mean pain score, are addressed in Table 2. The overall mean pain score for the TWT group was 5.82 ± 0.16, while for the BET group it was 7.00 ± 0.15. This difference was statistically significant ($P < 0.001$). The maximum pain score was observed on the first postoperative day for both groups. On all postoperative days, the pain score in the TWT group was significantly lower ($P < 0.001$) compared with the pain score in the BET group.

Return to Normal Diet Time

The mean return to normal diet time was 8.44 ± 0.12 (mean ± SEM) days (range 7 ± 10 days) for the TWT group, and 12.01 ± 0.30 (mean ± SEM) days (range 8-14 days) for the BET group. This difference was statistically significant ($P < 0.001$) (Table 1).

Postoperative Hemorrhage

Primary hemorrhage occurred in 1 subject of the BET group. There were 9 patients (4 of the TWT group and 5 of the BET group) who returned claiming secondary postoperative hemorrhage. In 5 patients (2 of the TWT group and 3 of the BET group), physical examination did not reveal any blood in the mouth or pharynx, and these patients were discharged without any consequences. In 1 (1.2%) subject of the TWT group as well as in 3 (4.3%) subjects of the BET group, bleeding or a blood clot within the tonsillar fossa was confirmed, and those patients were all hospitalized. In one patient of the BET group, control of the hemorrhage under general anesthesia was required (Table 1).

Other Complications

Slight peritonsillar and uvula edema occurred in 7 patients (8.64%) of the BET group but, resolved within 24 hours with no additional medication. No uvula or peritonsillar edema was noticed in the TWT group. No other complication occurred in both groups.

DISCUSSION

The Thermal Welding System is a new type of surgical instrument that uses simultaneously direct thermal energy and pressure to coagulate and divide blood vessels and other tissue. The thermal energy–producing element is a simple resistance heating wire driven by low-voltage direct current, so no electric current passes through the tissues grasped between the instrument's jaws, as happens with bipolar electrocautery. The active part of the instrument is comprised of a nichrome heating element with a thermally insulating backing that isolates the heating effect of the nichrome wire from the rest of the instrument and prevents the underside of the jaw from becoming hot (Fig 1C). Closing of the instrument jaws presses the thermal element against a silicone "boot" that is mounted on the other jaw of the device. The silicone "boot" helps to create a graded thermal profile, which consists of a narrow high-temperature cut zone that is flanked on each side by a lower-temperature coagulating zone. The graded temperature profile is crucial to the functioning of the instrument and enables the device to perform both cutting and coagulation simultaneously. Due to radiation of the heat from the nichrome element, the width of the cut zone is somewhat greater than the actual physical diameter of the wire. In this region, the temperature is high enough to actually cut tissue by means of direct vaporization with very little charring. This temperature has been measured in the range of 300-400°C. At distances greater than approximately 500 microns from the center of the wire, the temperature falls down to below 100°C, which is the ideal temperature range to coagulate and seal tissues by means of protein denaturation. Furthermore, the silicone "boot" exerts pressure or crimps the vessel walls together in the lower-temperature coagulation zone, producing a strong seal on the ends of the cut vessel. This pressure effect along with the thermal denaturation of the tissue produces coagulation and sealing. The effect produced on a vessel by the instrument is to cut it cleanly while producing a coagulated (sealed) zone at the ends of the vessel on either side of the cut.[4,5]

In this study, as well as in a former study of our department,[5] the TWS provided sufficient hemostasis, since there was no measurable intraoperative bleeding in the TWT group, while secondary postoperative hemorrhage occurred in 1 patient of the TWT group as well as in 3 patients of the BET group.

Due to the aforementioned minimal thermal spread of the TWS to the adjacent tissues, postoperative pain seems to be minimal. In our series, the mean pain score on all postoperative days, as well as the overall mean pain score of the TWT group, was significantly lower ($P < 0.001$) than those of the BET group, while the mean return to normal diet time

was also significantly lower ($P < 0.001$) in favor of the TWT group. Moreover, no signs of thermal injury were noticed in the TWT group, while slight peritonsillar and uvula edema occurred in 8.64% patients of the BET group.

Among the handpieces available for the TWS generator, the Bayonet UltraSlim Forceps (110-005D) was used. It is a single-use, footswitch-activated, hand-held surgical instrument, easy to handle without the need for special training, which costs approximately 280 € / US$340. Recently, there have been controversial suggestions of an estimated 1:5000 risk of acquiring variant Creutzfeld Jakob disease (v-CJD) as a result of tonsillectomy with reusable surgical instruments. The use of disposable instruments was implemented during the year 2000 in the United Kingdom.[6] On the other hand, disposable instruments have been associated with an increased morbidity of postoperative hemorrhage.[7-9] The Bayonet UltraSlim Forceps (110-005D) used in thermal welding tonsillectomies is entirely compliant with guidelines for the use of disposable instrumentation, as it is a single-use instrument providing safety against v-CJD transmission, as well as sufficient hemostasis.

CONCLUSION

In conclusion, we believe that the thermal welding tonsillectomy procedure could prove to be a cost-effective alternative to disposable tonsillectomy instruments, providing sufficient hemostasis, lower postoperative pain, quick return to normal diet, and safety against v-CJD transmission.

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