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Effect of Cooling Irrigating Saline in Tongue Base Ablation in Obstructive Sleep Apnea

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Abstract

Objective. Plasma is formed by creating a high-density energy field within an electrically conductive fluid such as saline. Sometimes ablated bits of tissue get stuck between the electrodes of the wand, obstructing the suction channel. The purpose of this study is to investigate the effect of cooling the irrigating saline during ablation of the hypertrophied tongue base in patients with obstructive sleep apnea.

Study Design. Prospective randomized controlled trial.

Setting. An otorhinolaryngology department in Main University hospitals.

Methods. Sixty adult patients with obstructive sleep apnea and tongue base hypertrophy underwent tongue base ablation surgery. Patients were randomly divided into 2 groups of 30 patients each: cooled saline and room temperature saline. The Coblation wand used was the EVac 70 Xtra HP (Smith & Nephew).

Results. In this study, a significant difference in operative time (mean $\pm$ SD) was seen between groups: 21.2 $\pm$ 5.5 minutes in the cold group and 47 $\pm$ 9.5 minutes in the control group (P = .001). The wands in the cold group did not obstruct, while all the wands in the control group were obstructed by tissue clogs with variable degrees, hence wasting more time to clean the wands' tips.

Conclusion. Cooling the irrigating saline overcame the problem of wand clogs, and the wand tip did not occlude at all during the procedures, thus saving time lost in wand cleaning and demonstrating a faster and safer surgical procedure. Further studies are needed to identify the hemostatic effect of the cooled saline over the regular one.

Keywords

Coblation surgery, cooled saline, obstructive sleep apnea, tongue base surgery, randomized controlled trial

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Plasma ablation technology was introduced in tonsillectomy in 1998.[1] Bipolar plasma ablation technology creates a controlled, stable plasma field to remove tissue at a low relative temperature, resulting in minimal thermal damage to surrounding soft tissues.[2]

Plasma ablation technology is not a thermal process; it is a chemical process, which means controlled ablation of tissues.[3] It means forming a plasma medium generated by the chemical process between the wands' active electrodes and saline. That reaction dissociates sodium chloride ions, separates hydrogen and oxygen atoms ''forming water of the irrigating saline solution,'' and subsequently produces free radicals that separate cell bonds. The temperature generated is a by-product, so plasma ablation technology is used to cut or ablate tissues at relatively low temperatures. It is estimated to be around 40° to 70° C.[4] This is unlike electrocautery, which works mainly by generating very high temperatures (around 400° C)[5] that cut different tissues. As such, Coblation causes minimal tissue dissolution and penetration when compared with electrocautery.[6,7]

Plasma ablation is a standard technology to perform surgery at the level of the tongue base.[8] It has suction irrigation and ablation coagulation capabilities. Its use to ablate and resect tongue-based tissues achieved comparable results versus transoral robotic surgery in a previous meta-analysis.[9,10] One of the problems of tongue base ablation surgery is repeated wand obstruction by tissue clogs.[11,12] Many steps are to be followed to open the obstructed wand to avoid its damage; however, prevention of wand clogs is better to save that time wasted in wand cleaning. The more time consumed during transoral tongue base surgery, the more time of compression

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on the tongue by the mouth gag blade and the more incidence of postoperative taste affection.

The purpose of this study is to investigate the effect of cooling the irrigating saline during ablation of hypertrophied tongue base in patients with obstructive sleep apnea (OSA). The hypothesis is that cooled saline can result in fewer clogs of the handpiece suction channel and hence result in faster and easier surgery, especially for beginners to the technology.

Materials and Methods

This study was approved by the ethics committee of Alexandria University, and all patients signed informed consent. The study was prospectively conducted on 60 consecutive patients with significant tongue base hypertrophy observed at preoperative drug-induced sleep endoscopy who underwent transoral Coblation endoscopic lingual lightening (CELL technique)[13] as stand-alone surgery. All patients were treated at the nose and palate level in a previous stage, leaving the tongue base to be done separately. All patients were experiencing moderate to severe OSA (apnea-hypopnea index [AHI] $\geq$15 events/h) and underwent surgery at the otorhinolaryngology department of Main University hospitals from January 2017 until December 2018.

Patients inclusion criteria were moderate to severe OSA (AHI $\geq$15 events/h), age between 18 and 65 years, body mass index (BMI) $\leq$35, failure of continuous positive airway pressure or low adherence to this treatment during the last 3 months (<4 hours per night), and main base of tongue collapses at drug-induced sleep endoscopy. Exclusion criteria included severe disease (psychiatric, cardiopulmonary, or neurologic), American Society of Anesthesiologists classification >3, previous tongue base surgery, significant craniofacial anomalies, pregnancy, no significant tongue base hypertrophy, and limited mouth opening that did not allow transoral access (interincisive distance <2.5 cm).

Patients were randomly divided into 2 groups: patients treated with cooled saline irrigation (cold group) and patients treated with room temperature saline irrigation (control group). Randomization was conducted by picking a piece of paper out of a box with a treatment order written on it (*regular* or *cold*), and then that piece of paper was placed back in the box. The chances of picking *regular* or *cold* were 50/50. The only different parameter in both groups was the saline temperature. Data registered for the analysis were as follows: age, sex, BMI, AHI, safety (defined by operative data; operation time, blood loss), postoperative bleeding and complications, and postoperative AHI by level 3 polygraphy after 6 months.

Cooling of saline was done by putting the saline used in irrigation in the refrigerator at least 1 hour before the intervention. The Coblation settings were 7 for ablation mode and 3 for coagulation mode. The Coblation handpiece used was EVac 70 Xtra HP (Smith & Nephew).

All patients were prepared and draped for surgery in the sniffing position (neck flexed and head extended), and exposure of tongue base was achieved: stay silk suture in the oral tongue to deliver tongue base, wide and short mouth gag blade inserted until the level of the circumvallate papillae to preserve taste sensation, and the Davis-Meyer mouth gag suspended to an ordinary Mayo stand. Then a 45° up-looking endoscope was inserted in the mouth, and ablation of tongue base tissue was done on each side of the midline (2-cm width and 1-cm depth of tissue ablation). The same technique was carried out by the same surgeon in all cases, with the only difference being the temperature of the irrigating saline. The surgeon was blinded regarding the irrigating saline temperature.

Statistical Analysis

All analyses were performed with Stata version 12.1 (StataCorp). A paired *t* test and 2-sample *t* test were used to compare means within and between groups. $P < .05$ was considered statistically significant. Sample size calculation was performed to determine whether the study had 80% power to detect differences between the groups of 50% (large) and 20% (small), with a 1-sided test (alpha = 0.05).

Results

A total of 60 patients (40 male) met the inclusion criteria and underwent transoral endoscopic tongue base ablation surgery. The mean ± SD age was 40.8 ± 9.5 years. The majority of patients (80%, 48/60) had severe OSA. No statistically significant differences between groups were observed in age, sex, preoperative BMI, and AHI (**Table 1**).

The mean irrigating saline temperature was measured by infrared thermometer used for objects and found to be 12.3°± 0.3° C in the cold group and 28.5°± 1.1° C in the control group ($P = .001$; **Figure 1**).

A significant difference in operative time was seen between groups ($P = .001$ at 95% CI), as measured from the start of tongue base exposure by the mouth gag until it was taken off. Operative time ranged from 15 to 30 minutes (mean, 21.2 ± 5.5 minutes) in the cold group and from 30 to 60 minutes (mean, 47 ± 9.5 minutes) in the control group (**Table 1**, **Figure 2**). All wands tips (100%) were obstructed with variable degrees in the control group, whereas that did not occur in the cold group.

All patients were extubated at the end of surgery with no postoperative intubation or tracheostomy. No patient required a feeding tube in the early postoperative period. Postoperative pain was measured by visual analog scale at the end of the first week after surgery (ie, 1 time frame only). Scores ranged from 3 to 7, and there was no significant difference in postoperative pain between the groups ($P = .21$; **Table 1**). No significant intraoperative bleeding was encountered, and if nonsignificant bleeding happened, it was instantly controlled with suction-irrigation-coagulation technology of the Coblation system.

Regarding postoperative complications, only 4 patients (2 from each group) reported a transient loss of taste sensation that resolved spontaneously within 6 weeks. No

Table 1. Clinical Characteristics and Operative Data of 60 Patients Undergoing the Coblation Endoscopic Lingual Lightening Technique.

	Mean	SD	*t*	*P* value
Age			0.397	.693
Cold	42.4	9.1		
Control	41.4	8.7		
BMI			0.818	.417
Cold	31.3	2.9		
Control	30.5	3.9		
Preoperative AHI			1.051	.298
Cold	37	10.4		
Control	34	10.5		
Postoperative AHI			0.759	.452
Cold	13	6.5		
Control	12	5.4		
Operative time			0.179	<.001[a]
Cold	21.2	5.5		
Control	47	9.5		
Postoperative pain: VAS			0.505	.579
Cold	3.8	0.9		
Control	4	1.2		

Abbreviations: AHI, apnea-hypopnea index; BMI, body mass index; VAS, visual analog scale.
[a]$P < .05$.

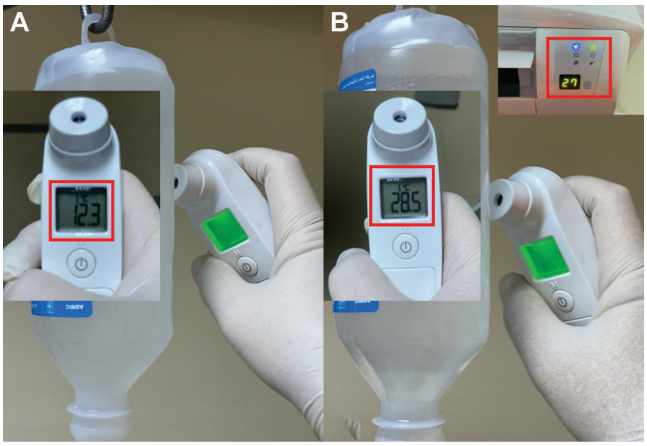

Figure 1. Temperature measurement of the saline used in irrigation: (a) cooled and (b) room temperature.

significant postoperative bleeding was registered in the cold group, whereas 5 patients in the control group (16.66%) presented with mild postoperative bleeding 10 days after surgery. However, the difference in bleeding between the groups was not the study's primary aim, and it is to be examined in a separate study.

Discussion

Li et al presented the CELL technique to ablate tongue base hypertrophy in patients with OSA by performing midline glossectomy.[13,14] The CELL technique was found to be

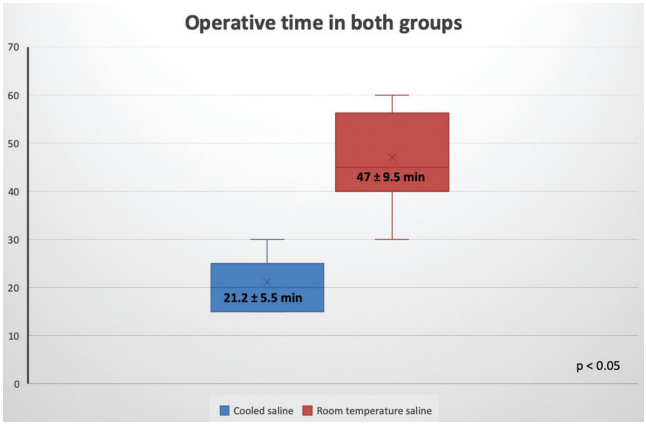

Figure 2. Histogram showing difference in operative time between the groups. Values are presented as mean (×), median (line), interquartile range (box), and 95% CI (error bars).

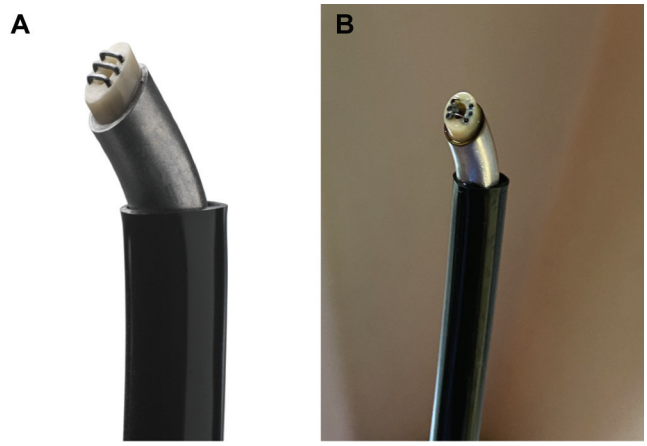

Figure 3. EVac 70 Xtra HP wand: (a) the 3 intact active electrodes and (b) the destroyed electrodes when tissue clogs obstructed the wand.

feasible and effective in treating patients with OSA at the tongue base level.

Sometimes ablated bits of tissue get stuck between the electrodes of the wand, obstructing the suction channel. The wand does not ''breathe'' anymore. Continuation of surgery despite imperfect suction will damage the active electrodes, which are sometimes harmful to tissues and will injure them (**Figure 3**). Some solutions are to be adopted in case of wand clogs:

- Gently wipe off the tip of the wand with a wet 4 × 4 from the Mayo stand, parallel to the electrodes. Before continuing with the dissection, hold the wand above a recipient on the Mayo stand and press the ablate pedal to remove any last remnants.
- Dip the tip of the wand into a plastic bowl with saline and gently rub the tip against the wall while pressing the ablate pedal.
- Back-flush the wand. Disconnect the suction, and connect a saline-filled syringe to the suction of the

wand. While holding the tip of the wand in a bowl filled with saline and pressing the ablate pedal, forcefully inject the saline from the syringe into the suction channel of the wand.

However, prevention of wand obstruction is better to save time wasted in cleaning the wand from the tissue clogs. The difference in operative time between the groups involved time lost in cleaning the wands from being obstructed by tissue clogs. In this experience, a significant decrease in operative time was found in the cold group (mean, 21.2 ± 5.5 minutes) as compared with the control group (mean, 47 ± 9.5 minutes). The temperature of irrigating saline was measured by an infrared thermometer used for objects and found to be 12.3°± 0.3° C in the cold group and 28.5°± 1.1° C in the control group (P = .001). The difference in operative time involved saving time wasted in cleaning wand tips when irrigating saline was used at room temperature (control group). All wands got blocked with variable degrees in the control group, but that did not occur in the cold group.

Some tricks are to be adopted to prevent such condition: do not bury the wand tip into the tissue. Rather, it is advised to hover the wand over the tissue and keep the wand tip moving all the time. Another great trick is to cool the saline used in irrigation by putting it in the refrigerator at least 1 hour before surgery.[10] This study was conducted to provide evidence on the advantage of cooling the saline to overcome the problem of wand clogs, as the wand tip did not occlude during the procedures, thus saving time lost in wand cleaning and allowing for faster surgery. Moreover, cold saline might help keep tongue base tissues cold; thus, a lower probability of tongue-based edema reduces the need to keep the patient intubated at the end of surgery.[8,15]

Study Limitations

Limitations included the small population and the lack of data on the effect of cooling the irrigating saline on bleeding control, which should be addressed in future studies.

Conclusion

Patients randomized to undergo tongue ablation with cooled saline irrigation had a significantly shorter operative time than controls with room temperature saline irrigation. The decrease in operative time was primarily attributed to fewer clogs of the headpiece suction channel. It is recommended to cool the irrigating saline by putting it in the refrigerator 1 hour before the intervention.

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Author Contributions

Ahmed Yassin Bahgat, the author applied the idea, conducted the study, performed surgery, performed statistics, wrote, and approved the final manuscript.

Disclosures

Competing interests: None.

Sponsorships: None.

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Ethical Approval and Consent to Participate

This study was approved by the ethics committee of Alexandria University (Institutional Review Board No. 00007556).

Informed Consent

Informed written consent was obtained from all participants included in the study.

Research Involving Human Participants

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Availability of Data and Material

The data sets used or analyzed during the current study are available from the corresponding author on reasonable request.

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