Attia and Hamdan
The Egyptian Journal of Otolaryngology (2023) 39:115
https://doi.org/10.1186/s43163-023-00476-2

The Egyptian Journal of Otolaryngology

ORIGINAL ARTICLE Open Access

Assessment of the protective role of submucosal saline injection of the inferior turbinates prior to submucosal diathermy or coblation techniques

Tamer M. Attia[1,2] and Ahmad M. Hamdan[1*]

Abstract

Background Inferior turbinate hypertrophy is a common cause of chronic nasal obstruction with many procedures for management including submucosal diathermy and coblation with a variation in their techniques. The aim of this study was to assess the protective role of submucosal saline injection in the inferior turbinates prior to submucosal diathermy or coblation techniques. A prospective cohort study was conducted on 80 patients diagnosed with bilateral hypertrophied inferior turbinates causing persistent nasal obstruction and not responding to medical treatment. The patients were distributed randomly and equally between 2 groups. Group I included 40 patients operated on with coblation of the inferior turbinates. Group II included 40 patients operated on with submucosal diathermy of the inferior turbinates. The right side of the nose of both groups had a saline injection of the inferior turbinates before the procedure and the left side of the nose did not have such injection. Each side of the nose in every patient was assessed for the degree of nasal crusting at 1 week postoperative, the presence of turbinate gangrene at 3 weeks postoperative, and the visual analog scale (VAS) of four symptoms (nasal discomfort, nasal pain, nasal obstruction, and thick nasal discharge) at 1 week postoperative.

Results In the coblation group, there was a significant difference between the right and left sides regarding the degree of crusting at 1 week postoperative, and a non-significant difference between the two sides regarding the presence of gangrene at 3 weeks postoperative. In the diathermy group, there was a significant difference between the right and left sides regarding the same parameters. Comparison between the injection and non-injection sides in each group regarding the nasal symptoms showed a highly significant difference between the two sides in each group favoring the injection side.

Conclusion Saline injection prior to inferior turbinate coblation or submucosal diathermy had a protective effect against crusting with both techniques and gangrene formation with submucosal diathermy. This was reflected on better postoperative nasal symptoms.

Keywords Crusting, Coblation, Gangrene, Inferior turbinate hypertrophy, Saline injection, Submucosal diathermy

*Correspondence:
Ahmad M. Hamdan
Ahmed.Hamdan@med.menofia.edu.eg
[1] Otolaryngology Head & Neck Surgery Department, Faculty of Medicine, Menoufia University, Shebin El-Kom, Egypt
[2] Otolaryngology Department, Saudi German Hospital, Dubai, United Arab Emirates

Background

The most frequent chronic presenting symptom experienced by otolaryngologists is likely nasal obstruction. The majority of patients with nasal blockage have either a septal deviation or turbinate hypertrophy caused by vasomotor or allergic rhinitis. The majority of cases of

Springer Open

© The Author(s) 2023. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by/4.0/.

nasal obstruction due to inferior turbinate hypertrophy are mild and respond to medical care, but occasionally surgery is necessary [1].

When medical treatments are ineffective for hypertrophic inferior turbinates, surgery would be the option of choice. The primary objective of surgical reduction of the inferior turbinate is to relieve nasal obstruction while maintaining the physiological role of the inferior turbinate. Over the years, numerous surgical methods have been documented and used. Regardless of the methods and tools used, there are two categories of surgical techniques: mucosal-sparing and non-mucosal-sparing. These categories are based on the preservation of the medial mucosa of the inferior turbinates. The non-mucosal-sparing techniques have been linked to postoperative complications like excessive bleeding, pain, and a protracted recovery period, despite being effective in relieving nasal blockage [2].

Submucosal diathermy of the turbinates is a non-mucosal sparing technique involving cauterizing turbinate tissue in a submucosal plane using an electrical current. With greater rates of postoperative crusting and nasal synechiae recorded, it is the least efficient in lowering the turbinate volume and improving nasal airway resistance. Due to the required high power and voltage, it can be difficult to estimate how much tissue is destroyed when performed submucosally. Additionally, there is a significant risk that the excessive temperatures generated will cause the surrounding tissue to be destroyed [3].

Coblation is a mucosal-sparing technique for treating inferior turbinate hypertrophy involving the administration of radiofrequency energy to the turbinates' soft tissue. It energizes the ions in a conductive fluid like saline to create a tiny plasma field by employing radiofrequency in a bipolar mode. It is characterized by a reduced thermal effect with less pain and a quicker recovery in the areas of tissue destruction. By vaporizing and dissolving the delicate erectile tissue, coblation causes diminution of the inferior turbinate size. The tissue fibrosis and volume loss are immediate and long-lasting. The inferior turbinate's further growth and hypertrophy are stopped by the mucosal contraction and anchoring to the periosteum as a result of fibrosis [4]. The aim of this study was to assess the protective role of submucosal saline injection in the inferior turbinates prior to submucosal diathermy or coblation techniques.

Methods

The current study was a prospective cohort study conducted after approval of the institutional review board and informed written consent was taken from every patient before participation in the study. The study included patients diagnosed with bilateral hypertrophied inferior turbinates causing persistent nasal obstruction and not responding to medical treatment. Patients with previous turbinate surgery, other nasal pathologies like significant septal deviation or nasal polyposis, and patients with surgical unfitness including bleeding tendency and uncontrolled systemic diseases were excluded from the study.

All patients in the study were evaluated by history taking to assess nasal obstruction using Nasal Obstruction Symptom Evaluation (NOSE) Instrument [5] with patients categorized as follows: mild (range, 5–25), moderate (range, 30–50), severe (range, 55–75), extreme (range, 80–100) nasal obstruction. Endoscopic examination of the nose was performed for every patient to confirm the finding of hypertrophied inferior turbinates. Inferior turbinate size was categorized using ordinal scales ranging from 1 to 4 based on the degree of obstruction caused by the anterior aspect of the inferior turbinate relative to the total airway space. It was graded as 0–25%, 26–50%, 51–75%, and 76–100% [6]. The study included patients with moderate to severe nasal obstruction and grade 3 or 4 inferior turbinate size with no response to medical treatment. Computed tomography of the nose and paranasal sinuses was done to exclude any hidden sinus pathology. Routine preoperative laboratory investigations were performed for every patient to assess the operative fitness.

The study included 80 patients distributed randomly and equally using block randomization methods between 2 groups. Group I included 40 patients operated on with coblation of the inferior turbinates with the right side of the nose having a saline injection of the inferior turbinate before coblation and the left side of the nose without saline injection. Group II included 40 patients operated on with submucosal diathermy of the inferior turbinate with the right side of the nose having a saline injection of the inferior turbinate before diathermy and the left side of the nose without saline injection.

All patients of both groups were operated on under general anesthesia with endotracheal intubation. Local decongestion of the nose was done with cotton stripes soaked with 1:100,000 adrenaline. In group I: Inferior turbinate coblation was performed using a bipolar cold ablation wand (Smith and Nephew REFLEX ULTRA◊ PTR and REFLEX ULTRA 45- Turbinate Reduction Wand) (Smith & Nephew, London, UK) The coblation wand, coated with an electrolyte gel, was inserted into the anterior part of the inferior turbinate and advanced submucosally till reached the posterior end of the inferior turbinate then ablation was performed while withdrawing the wand backward. Ablation was performed for a few seconds until blanching can be seen. This was repeated for 2 or 3 passes depending on the turbinate size

and degree of hypertrophy. In group II: Submucosal diathermy of the inferior turbinates was performed using a diathermy needle with a coagulation current of 70 W at 27.12 MHz frequency. inserted into the anterior end of the inferior turbinate and advanced submucosally until the posterior end of the turbinate was judged to have been reached. The needle was withdrawn over a period of 30 s with the current applied. This procedure was done twice on each inferior turbinate.

Postoperative assessment

The right and left sides of the nose were assessed separately postoperatively for the degree of nasal crusting at 1-week postoperative whether absent, mild, or severe. This scoring system was derived from the Lund-Kennedy score [7] in which nasal crusting was graded as 0 for no crusting, 1 for mild to moderate crusting, and 2 for moderate to severe crusting. In addition, the right and left sides of the nose were assessed separately postoperatively for the presence or absence of gangrene of the inferior turbinates at 3 weeks postoperative as evaluated endoscopically. Four nasal symptoms including nasal discomfort (including a wide variety of symptoms other than pain like itching, foreign body sensation, and stuffiness), nasal pain, nasal obstruction, and thick nasal discharge, were assessed for each side of the nose at 1 week postoperative using a visual analog scale (VAS) where every patient was asked to give each side of his nose a score out of 10 for each symptom.

Outcomes

The outcomes of the study included a comparison between the right and left sides of each group regarding the degree of crusting at 1-week postoperative, the presence of gangrene of the inferior turbinates at 3 weeks postoperative, and an assessment of the difference in the four evaluated nasal symptoms between the two sides of the nose in each group at 1 week postoperative.

Statistical analysis

Data of the study were subjected to statistical analysis using Statistical Package of Social Science (SPSS) version 23 (IBM Corp., Armonk, NY, USA). Qualitative variables were presented as numbers and percentages, while quantitative variables were presented as mean, and standard deviation. Assessment of data distribution was done using the Kolmogorov–Smirnov test showing the non-normal distribution of the data. The comparison between paired quantitative data of each group was done using the Wilcoxon sign rank test. The comparison between qualitative variables was done using the chi-square test and Fisher exact test (if less than 75% of the values were more than 5). A two-sided p-value of (<0.05) was considered statistically significant, while a p-value of (<0.001) was considered highly significant.

Results

The current study included 80 patients distributed into two groups; group I included 40 patients subjected to inferior turbinate coblation and distributed as 28 (70%) males and 12 (30%) females with a mean age of 31.4 years ± 5.71SD. Group II included 40 patients subjected to submucosal diathermy of the inferior turbinate and distributed as 21 (52.5%) males and 19 (47.5%) females with a mean age of 30.23 years ± 5.64 SD. There was a nonsignificant difference between the two groups regarding age and sex ($p=0.25$ and 0.11, respectively) (Table 1).

In the coblation group, there was a significant difference between the right (injection) and left (non-injection) sides regarding the degree of crusting at 1 week postoperative ($p=0.04$) being less in the injection sides, while there was a non-significant difference between the two sides regarding the presence of gangrene at 3 weeks postoperative ($p=1$) (Table 2).

In the diathermy group, there was a significant difference between the right (injection) and left (non-injection) sides regarding the degree of crusting at 1 week postoperative and the presence of gangrene at 3 weeks postoperative ($p=0.011$ and 0.034, respectively) being less in the injection sides (Table 2).

Comparison between the injection and non-injection sides in both groups regarding the nasal symptoms showed a highly significant difference between the two sides in both groups regarding the VAS scores for all four postoperative symptoms with less scores in the injection sides in both groups for all symptoms ($p<0.00001$ for all) (Table 3). There were no complications specific to saline

Table 1 Comparison between the two study groups regarding the demographic data

Variable		Group I		Group II		Statistical test	*p* value
Age (mean ± SD)		31.4 ± 5.71		30.23 ± 5.64		$Z=1.14508$	0.25
		No	%	No	%		
Gender	**Male**	28	70	21	52.5	Chi = 2.5806.	0.11
	Female	12	30	19	47.5		

Table 2 Comparison between the right (injection) side and left (no-injection) side in each group regarding endoscopic findings

Variable		Right side		Left side		Statistical test	*p* value
		No	%	No	%		
Group I (coblation group)							
Crustings At 1 week	**Absent**	12	30	5	12.5	6.4601	0.04
	Mild	23	57.5	22	55		
	Severe	5	12.5	13	32.5		
Gangrene At 3 weeks	**Present**	1	2.5	2	5	Fisher exact test $P=1$	
	Absent	39	97.5	38	95		
Group II (diathermy group)							
Crustings At 1 week	**Absent**	4	10	1	2.5	8.9991	0.011
	Mild	24	60	14	35		
	Severe	12	30	25	62.5		
Gangrene At 3 weeks	**Present**	3	7.5	10	25	4.5006	0.034
	Absent	37	92.5	30	75		

Table 3 Comparison between the right (injection) side and left (no-injection) side in each group regarding nasal symptoms

Variable	Right side Mean ± SD	Left side Mean ± SD	Statistical test	*p* value
Group I (coblation group)				
Nasal discomfort	6.95 ± 0.81	8.075 ± 0.76	$z=-5.5109$	< 0.00001
Nasal pain	7.025 ± 0.73	8.1 ± 0.67	$z=-5.5109$	< 0.00001
Nasal obstruction	5.05 ± 0.78	6.1 ± 0.74	$z=-5.5109$	< 0.00001
Thick nasal discharge	7.15 ± 0.74	8.175 ± 0.71	$z=-5.5109$	< 0.00001
Group II (diathermy group)				
Nasal discomfort	7.275 ± 0.68	8.325 ± 0.65	$z=-5.5109$	< 0.00001
Nasal pain	7.4 ± 0.59	8.275 ± 0.68	$z=-5.1594$	< 0.00001
Nasal obstruction	5.475 ± 0.55	6.375 ± 0.59	$z=-5.2316$	< 0.00001
Thick nasal discharge	7.35 ± 0.62	8.2 ± 0.61	$z=-5.0862$	< 0.00001

injection in both groups with the postoperative outcomes of crusting and gangrene being related only to the coblation or submucosal diathermy techniques.

Discussion

Inferior turbinate surgery can target both the bone and the mucosal components of turbinate hypertrophy, whereas medicinal treatment focuses exclusively on mucosal reduction. Over the past century, numerous methods and variations have been created and improved. Cost, effectiveness, desire for general anesthesia, and limiting postoperative problems including bothersome bleeding, adhesion formation, and crusting are factors to be taken into account while choosing a procedure [1]. One of the most bothersome side effects of turbinate surgery, with various degrees of severity depending on the procedure, is nasal crusting with consequent nasal discomfort and obstruction.

Coblation (short for "cold ablation") is a technique for removing soft tissue by creating a plasma field using radiofrequency current generated between bipolar electrodes. A thermal lesion persists after a portion of the tissue has vaporized causing additional soft tissue attenuation and contracture, and they increase over time. Patients with predominantly bony turbinate hypertrophy should not be subjected to this method since it merely reduces soft tissue volumes; these patients may benefit more from conventional submucous turbinate excision [8]. Electric diathermy involves using an electric current with greater incidences of postoperative crusting and nasal synechiae and high risk of destruction of adjacent tissues caused by the high temperature generated [9].

The manufacturer's guide for reflex 45 Smith and Nephew coblation wand used in our study for coblation of the inferior turbinates has provided a standard procedure for inferior turbinate coblation which described that

before each insertion of the wand into the turbinate, the wand tip should be placed in saline gel or other conductive media to ensure the initial formation of the plasma field [10]. Some authors have used saline injection into the turbinate to increase the plasma field generated by the wand [2]. Our study aimed to assess the value of such saline injection in minimizing postoperative crusting and gangrene after the techniques of coblation or submucosal diathermy of the hypertrophied inferior turbinate. The perspective of the study was based on the hypothesis that doubling the turbinate cross-sectional area by injecting 10 ml of saline would allow a minimal surface mucosal thermal injury from the coblation or submucosal diathermy by providing an intervening space between the mucosa and the submucosal wand or needle. This saline injection would also allow a homogenous distribution of heat within the turbinate erectile tissue.

In a study by Salinas and Barrera [11], fifteen fresh pig tongue specimens were injected with normal saline, and a single coblation probe was used to apply various submucosal lesions to the tongue specimens at different energy settings. Saline injections were not given prior to the control lesions. The porcine tongue samples were sectioned and inspected after the lesions were made. For each of the specimens, the size and kind of lesions were noted and compared among energy settings. With an average lesion area of 1.20 to 2.87 cm^2, visible lesions were produced by coblation with saline injection. As the setting increased, the average lesion area grew. The average lesion area without saline injection ranged from 0.15 to 0.8 cm^2.

In a porcine turbinate model, Vogt et al. [12] examined the thermal effects of coblation and radiofrequency waves. They discovered that temperatures were exceptionally high upon activation in all of the coblation sessions and temporarily exceeded 1000 °C. These temperatures fluctuated between 300 and 600 °C on average. The release of plasma following the injection of saline solution explains this phenomenon. A maximum temperature of 380 °C was only briefly attained during coblation without saline infusion, which may have been coincidental. The coblation wand appears to function without saline injection similar to any other concentric bipolar electrode used with previous systems and generates a spindle-like electrical field between the poles.

In the current study, both groups showed a significantly lower incidence of nasal crusting at 1 week postoperative on the injection side compared with the non-injection side. This finding explains the highly significant lower scores of nasal obstructions and thick nasal discharge in the injection side compared with the non-injection side in both groups being closely related to the degree of nasal crusting. On the other hand, the diathermy group showed significantly less gangrene at 3 weeks postoperative in the injection side compared with the non-injection side. This finding could explain the highly significant lower scores of nasal discomfort and nasal pain on the injection side compared with the non-injection side in this group. The contradiction between our findings and the higher temperature induced with saline injection described in the previous studies can be explained by the assumption that the injected saline allows uniform distribution of the energy all through the turbinate tissue without localization to a specific point causing its extensive destruction and subsequent crusting and gangrene formation. Saline solutions, which are made up of dissolved ionic salts in water, are electrically conductive because they include dissociated and mobile ions with this conductivity inversely proportional to ions concentration. Isotonic saline has a conductivity at ambient temperature (23 °C) that is closer to that of an excellent electrical conductor like titanium metal. This conductivity roughly doubles with every 40 °C increase in the temperature because temperature changes have a significant impact on the way current flows in an electrosurgical field [13]. Further studies are needed to confirm these findings allowing saline injection to be recommended as a routine before coblation or submucosal diathermy of the hypertrophied inferior turbinates.

Conclusion

Saline injection prior to inferior turbinate coblation or submucosal diathermy had a protective effect against crusting with both techniques and gangrene formation with submucosal diathermy. This was reflected on better postoperative nasal symptoms.

Abbreviations

VAS	Visual analog scale
SPSS	Statistical Package for Social Science

Acknowledgements

Not applicable for this article.

Authors' contributions

TA provided the concept, design with the definition of the intellectual content, clinical studies, data collection, and manuscript editing. AH conducted literature research, clinical studies, data collection, data analysis, and manuscript preparation. All authors have read and approved the manuscript.

Funding

No funding for this research.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
This study was approved by the institutional review board of Menoufia Faculty of Medicine with approval number 6/2022-ENT-21. The participants of the study provided written consent before participation in the study.

Consent for publication
Not applicable.

Competing interests
No potential competing interests relevant to this article were reported for any of the authors.

Received: 8 January 2023 Accepted: 7 July 2023
Published online: 24 July 2023

References

1. Brunworth J, Holmes J, Sindwani R (2013) Inferior turbinate hypertrophy: review and graduated approach to surgical management. Am J Rhinol Allergy 27(5):411–415
2. Abdullah B, Singh S (2021) Surgical interventions for inferior turbinate hypertrophy: a comprehensive review of current techniques and technologies. Int J Environ Res Public Health 18(7):3441
3. Fradis M, Malatskey S, Magamsa I, Golz A (2002) Effect of submucosal diathermy in chronic nasal obstruction due to turbinate enlargement. Am J Otolaryngol 23(6):332–336
4. Woloszko J; Gilbride C (2000) Coblation technology: Plasma-mediated ablation for otolaryngology applications. In: Anderson RR, Bartels KE, Bass LS, (Eds). Proceedings of the SPIE: Lasers in Surgery: Advanced Characterization, Therapeutics, and Systems X. SPIE–The International Society for Optical Engineering: Bellingham, WA, USA, 3907: 306–316
5. Stewart MG, Witsell DL, Smith TL, Weaver EM, Yueh B, Hannley MT (2014) Development and validation of the Nasal Obstruction Symptom Evaluation (NOSE) scale. Otolaryngol Head Neck Surg 130(2):157–163
6. Camacho M, Zaghi S, Certal V, Abdullatif J, Means C, Acevedo J, Liu S, Brietzke SE, Kushida CA, Capasso R (2015) Inferior turbinate classification system, grades 1 to 4: development and validation study. Laryngoscope 125(2):296–302. https://doi.org/10.1002/lary.24923. Epub 2014 Sep 12 PMID: 25215619
7. Lund VJ, Kennedy DW (1997) Staging for rhinosinusitis. Otolaryngol Head Neck Surg 117(3 Pt 2):S35
8. Bhattacharyya N, Kepnes LJ (2003) Clinical effectiveness of coblation inferior turbinate reduction. Otolaryngol Head Neck Surg 129(4):365–371
9. Passali D, Passali FM, Damiani V, Passali GC, Bellussi L (2003) Treatment of inferior turbinate hypertrophy: a randomized clinical trial. Ann Otol Rhinol Laryngol 112:683–688
10. Smith and Nephew brochures. REFLEX ULTRA◊ PTR and REFLEX ULTRA 45- Turbinate Reduction Wands. Available at: https://www.smith-nephew.com/professional/products/all-products/reflex-ultra-ptr-and-reflex-ultra-45/. Accessed at 12–9–2022
11. Salinas NL, Barrera JE (2010) Coblation lesion formation in a porcine tongue model. Otolaryngol Head Neck Surg 143(3):448–453
12. Vogt K, Daine-Loza I, Sperga M (2018) Comparison of the thermal effects of Coblation and Radiofrequency waves in a porcine turbinate model. Rom J Rhinol 8(31):157–164
13. Stalder K, Ryan T, Woloszko J (2013) Some Physics and Chemistry of Coblation (R) Electrosurgical Plasma Devices. Progress in Biomedical Optics and Imaging - Proceedings of SPIE. 8584:85840P–10

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Submit your manuscript to a SpringerOpen journal and benefit from:

► Convenient online submission
► Rigorous peer review
► Open access: articles freely available online
► High visibility within the field
► Retaining the copyright to your article

Submit your next manuscript at ► springeropen.com