Original Article
http://mjiri.iums.ac.ir

Medical Journal of the Islamic Republic of Iran (MJIRI)
Iran University of Medical Sciences

Impact of endoscopic endonasal pituitary surgery on nasal airway patency

Maryam Jalessi[1], Mohammad Farhadi[2], Alimohamad Asghari[3], Maryam Hosseini*[4]
Elahe Amini[5], Seyyed Behzad Pousti[6]

Received: 21 May 2015 Accepted: 3 October 2015 Published: 30 May 2016

Abstract

Background: Nose is used as a corridor in endoscopic endonasal transsphenoidal approach (EETSA) for pituitary adenoma. Thus, it may affect the nasal airway patency, function and sinonasal-related quality of life. The aim of this study is to objectively and subjectively evaluate these effects.

Methods: In this prospective study, 43 patients with pituitary adenoma who were candidates for EETSA from March 2012 to October 2013 were enrolled. The patients were evaluated preoperatively using acoustic rhinometry and rhinomanometry (with/without the use of decongestant drops) and asked to complete the 22-Item Sinonasal Outcome Test (SNOT-22) questionnaire. The tests were repeated at one and three months postoperatively. The preoperative data were compared with the first and second postoperative ones using paired-sample t-test.

Results: Without the use of decongestant drops, the total airway resistance increased significantly ($p=0.016$), and the nasal airflow decreased significantly ($p=0.031$) in the first postoperative evaluation. However, in the 3rd postoperative month, the difference was not significant. With the use of decongestant drops, the objective parameters showed no significant changes compared to preoperative data even at the first evaluation. The SNOT-22 scores also did not differ significantly in 1st and 3rd postoperative months. The first postoperative SNOT-22 showed a strong correlation with the second minimal cross-sectional area on simultaneous evaluation, and with the preoperative total airway resistance.

Conclusion: EETSA has a transient adverse effect on the nasal patency that quickly improves, making it a safe approach for the sinonasal system. Rhinomanometry is the most sensitive test for detecting these nasal functional changes objectively.

Keywords: Pituitary adenoma, Endoscopy, Skull base, Rhinomanometry, Acoustic rhinometry.

Cite this article as: Jalessi M, Farhadi M, Asghari A, Hosseini M, Amini E, Pousti SB. Impact of endoscopic endonasal pituitary surgery on nasal airway patency. *Med J Islam Repub Iran* 2016 (30 May). Vol. 30:379.

Introduction

Since their introduction, surgical approaches to pituitary adenoma have gone through revolutions from the transnasal to the transcranial, and again to the transnasal route (1). Adopting the endonasal transsphenoidal route, either endoscopic or microscopic, the nasal pathway is manipulated to reach the tumor by housing the instruments during the tumor removal and/or developing local flaps or grafts to repair the skull base defect, etc. (2). Hence, sinonasal complications of these approaches have been the subject of an investigation by several authors (3,4). The same is true for the actual weight of this complication on the patient's sinonasal-related quality of life (QOL) (4-6). However, the objective eval-

1. MD, Associate Professor of Otolaryngology- Head and Neck Surgery, Skull Base Research Center, ENT and Head & Neck Research Center and Department, Hazrat Rasoul Akram Hospital, Iran University of Medical Sciences, Tehran, Iran. jalessimd@gmail.com
2. MD, Professor of Otolaryngology- Head and Neck Surgery, ENT and Head & Neck Research Center and Department, Hazrat Rasoul Akram Hospital, Iran University of Medical Sciences, Tehran, Iran. farhadi28@gmail.com
3. MD, Associate Professor of Otolaryngology- Head and Neck Surgery, ENT and Head & Neck Research Center and Department, Hazrat Rasoul Akram Hospital, Iran University of Medical Sciences, Tehran, Iran. dramasghari@gmail.com
4. (**Corresponding author**) MD, Research Assistant, ENT and Head & Neck Research Center, Iran University of Medical Sciences, Tehran, Iran. sbresearchcenter@gmail.com
5. MD, Research Assistant, Skull Base Research Center, ENT and Head & Neck Research Center, Iran University of Medical Sciences, Tehran, Iran. elaheaminimd@gmail.com
6. MD, Associate Professor of Otolaryngology- Head and Neck Surgery, ENT and Head & Neck Research Center and Department, Hazrat Rasoul Akram Hospital, Iran University of Medical Sciences, Tehran, Iran. sb_pousti@yahoo.ca

uation of the nasal pathway after endoscopic endonasal transsphenoidal approach (EETSA) seems to be the focus of only a few studies.

Acoustic rhinometry and rhinomanometry are the two commonly used tests for the evaluation of the nasal pathway (7-10). Rhinomanometry, as a dynamic method, is a way to assess the nasal patency. It is based on the simultaneous recording of the nasal airflow and pressure difference between the anterior and the posterior sections of the nasal cavity (7,8). The pathway resistance is then calculated from their values. Acoustic rhinometry, as a tool to evaluate the nasal pathway geometry, is designed to measure nasal volume, minimal cross-sectional areas (MCAs), and their distances from the nostrils (9,10). It is based on the reflected sound waves emitted from a spark as a source.

To evaluate the impact of any subjective change on the patients' sinonasal-related QOL, the 22-Item Sino-nasal Outcome Test (SNOT-22) questionnaire can be used, which is considered a useful, reliable, valid, and responsive instrument by several authors (11).

This study was designed to evaluate the patients undergoing EETSA for pituitary adenoma using rhinomanometry and acoustic rhinometry to assess the objective changes in the nasal pathway along with the SNOT-22 questionnaire for the evaluation of the subjective changes in the sinonasal-related QOL.

Methods

Study Population

In this prospective study, 43 eligible patients with pituitary adenoma who were candidates for EETSA in a tertiary care center from March 2012 to October 2013 were enrolled. Cases with the severe septal deviation (deviation touching the lateral nasal wall) or para-nasal sinus problems requiring additional surgery were not included. The Ethics Committee of the ENT and Head and Neck Research Center approved the study, and all procedures were in accordance with Helsinki Declaration. Written informed consent was obtained from the patients. The related preoperative evaluation included nasal endoscopy, acoustic the rhinometry, and rhinomanometry. All the patients were also asked to complete the SNOT-22 questionnaire as a subjective test. The reevaluations were performed using the same tests at one and three months postoperatively.

Objective and Subjective Measurements

An acoustic rhinometer (A1, GM company instruments, UK) was used to evaluate the first and second MCAs (MCA1 and MCA2, cm^2) along with their distance from the nasal orifices (d1 and d2, cm) to find out any shifting of MCAs. The measured volume (cm^3) corresponds to the first 5 cm of the nasal cavity (0-5 cm from the nasal entrance). The results were presented as the average of the right and left nasal cavities for each parameter.

A rhinomanometer (NR6, GM company instruments, UK) was used to evaluate the nasal airflow (at the pressure of 150 Pascal) and total airway resistance to airflow ($Pa/cm^3/s$). Also, the average of the right and left nasal cavities' airflow was considered for comparison. All the measurements were performed according to the regulations of the standardization committee on objective assessment of the nasal airway, International Rhinology Society (IRS), and European Rhinology Society (ERS) (7). Both tests were used before and after the use of decongestant drops (phenylephrine 0.5%, 10 minutes before the test). The sinonasal-related QOL was measured by the standardized Persian version of the self-reported SNOT-22 questionnaire (12). It has 22 items, and each item is scored from 0 to 5. The sum of the scores (0-110) was calculated and used for the comparison. Higher scores indicated a worse situation.

Surgical Technique

The pure EETSA was adopted. The inferior turbinates were out-fractured bilaterally. The middle turbinate was partially resected when the pathway was too narrow, or there was a concha bullosa. A binostril approach was adopted through either a septal mucosal incision 2 mm anterior to the rostro-vomerian junction or transosteal with wide removal of the face of the sphenoid sinus. As the removal of the sphenoid rostrum commonly provides a considerable space for the binostril approach, posterior septectomy was carried out after this step to be able to tailor the septectomy and alleviate the need for a larger septal resection. The other steps of the approach have been already described (13). The four-handed binostril approach was adopted by a team including a neurosurgeon and a rhinologist. The first author as the otolaryngologist of the surgical team performed the entire nasal, sphenoidal, and reconstruction phases of the operations.

Statistical Analysis

Data is presented as mean ± SD for quantitative variables. Paired-sample t-test or Wilcoxon test (if the variable presented as non-parametric pattern) was used to compare postoperative data of rhinomanometry, acoustic rhinometry, and the SNOT-22 with the corresponding preoperative data. The Pearson or Spearman (if required) correlation test was used to analyze the correlation between quantitative values. P-values less than 0.05 were considered statistically significant. All statistical analyzes were performed using SPSS (version 22.0, IBM Corp., Armonk, NY, USA).

Results

All of the 43 patients had pathologically proven pituitary adenoma. Twenty-four patients (55.8%) were female, and 19 (44.2%) were male. The mean age of the patients was 38.2 ± 14.22 years (ranging from 18 to 76 years). Nine patients (20.93%) had microadenoma, and 34 (79.07%) had macroadenoma. None of them required revision surgery during the study period. There was no postoperative epistaxis, septal perforation, cerebrospinal fluid leak, or bacterial meningitis in these cases.

To evaluate any postoperative change, the first and second postoperative MCA1, MCA2, d1, d2, and nasal volume measured by acoustic rhinometry were compared against the preoperative data (both in normal and post-decongested state) that showed no statistically significant differences in any of them. Objective parameters without the use of decongestant drops are shown in Table 1.

According to the rhinomanometry test, in the patients who did not receive the decongestant drops, the total nasal airway resistance had a significant increase in the first month after the surgery (p=0.016), but the difference was not significant in the 3rd postoperative month (Table 1). Accordingly, in the same patients, the nasal airflow showed a significant decrease on the first postoperative evaluation (p=0.031), but there was no significant difference compared to the baseline values on the second assessment (Table 1).

However, in the patients who received a vasoconstrictor, there were no significant

Table 1. Mean ± SD of the objective parameters assessed by acoustic rhinometry and rhinomanometry without the use of decongestant drops

Variable	Pre-op (N=43)	First-month post-op (N=36)	Third-month post-op (N=24)
Nasal airflow	285.65 ± 96.751	219.27±120.007 *	295.06 ± 120.709
Total resistance	0.31 ± 0.153	0.46 ± 0.309 *	0.29 ± 0.128
Volume	9.21 ± 2.898	9.02 ± 3.352	9.22 ± 3.059
MCA1	0.91 ± 0.233	0.89 ± 0.206	0.92 ± 0.185
MCA2	1.04 ± 0.574	0.86 ± 0.500	0.79 ± 0.186
d1	0.74 ± 0.433	0.76 ± 0.482	0.64 ± 0.395
d2	2.34 ± 0.587	2.41 ± 0.639	2.32 ± 0.556

Pre-op: preoperative, Post-op: postoperative, N: number, MCA1: first minimal cross-sectional area, MCA2: second minimal cross-sectional area, d1: distance between MCA1 and nostril, d2: distance between MCA2 and nostril
* Significant difference from preoperative data

changes in any of the above-mentioned parameters of acoustic rhinometry and rhinomanometry when comparing the data of each postoperative assessment with the preoperative data.

Although not statistically significant, the SNOT-22 score increased in the first month after the surgery (25.47±15.297 vs. 18.79±14.715, p=0.140) but then decreased below the preoperative score in the 3rd postoperative month (15.08±13.500 vs. 18.79±14.715, p=0.211).

Without decongestant drops, the SNOT-22 score in the 1st month after the surgery had a significant inverse correlation with MCA2 in the same time (r=-0.477, p=0.012), and a significant direct correlation with total airway resistance on the preoperative evaluation (r=+0.443, p=0.011). However, there was no significant correlation between objective and subjective parameters in the post-decongestion state.

Discussion

In this study, the results showed no significant changes in acoustic rhinomanometry routine parameters (MCA1, MCA2, d1, d2, and volume) and SNOT-22 after the surgery.

The lack of significant deterioration in acoustic rhinomanometry parameters may be due to the fact that MCA1 which is related to the nasal valve area does not change using the approach. Also outfracturing of the inferior turbinates during the surgery increases the space which can somehow encompass the mucosal swelling at the area that correlates with the MCA2. However, in a recent study on patients who underwent endoscopic transsphenoidal surgery for a variety of skull base pathologies by acoustic rhinometry, the cross-sectional area of the nasal cavity in the anterior and mid-portion of the middle turbinate showed a significant increase after the surgery (14). But, these areas are not compatible with standard MCA1 and MCA2. In the same study, the postoperative SNOT-22 changes did not show a strong correlation with changes in acoustic rhinometry values (14). However, the MCA has been shown to be the best parameter for predicting patient satisfaction (after septoplasty) (15). Our results also showed a strong negative correlation between SNOT-22 and MCA2 (in the non-decongestant state) in the first postoperative month indicating that the smaller the MCA2, the worse the patient's sinonasal-related QOL.

Our results showed that the sinonasal-related QOL did not significantly change even on the early postoperative evaluation (first month postoperative). Although some studies showed deterioration of SNOT-22 score in the early postoperative period after endoscopic skull base surgery, their patients were heterogeneous according to the pathology and the extent of the approach (6,16,17). But it should be kept in mind that the SNOT-22 has not yet been standardized for use in this type of surgery and the improved postoperative psychological status of the patients may affect the total score and conceal the mild early postoperative deterioration of sinonasal symptoms (5,11).

In contrary, in the rhinomanometry test, the total resistance of the nasal pathway and the nasal airflow (without the use of decongestant drops) showed significant deterioration in the first postoperative month that returned to the baseline in the third postoperative month. Minimal edema of the nasal mucosa after the surgery can be the reason for this deterioration of patency in the early postoperative period as the changes were not significant with the use of the decongestant. It shows that total airway resistance and nasal airflow parameters of the rhinomanometry test are very sensitive to minimal edema of the nasal pathway as they evaluate a more generalized area of the nasal cavity (compared to acoustic rhinometry parameters). However, in a study by Frank et al. (18), 40 patients were analyzed using the rhinomanometry test before and one and three months after EETSA. As this test was a part of a larger study, the results of the test were not mentioned in detail. However, they did not find any deterioration in the nasal functionality in rhinomanometry (18).

In this study, the preoperative total airway resistance showed a strong positive correlation with the SNOT-22 in the first postoperative month. As the patients with severe septal deviation and paranasal sinus disease were excluded from the study, this correlation may suggest that the patients with subtle rhinitis (e.g. allergic rhinitis) would encounter more deterioration of the sinonasal-related QOL after the surgery. The same finding has been demonstrated in patients who have undergone septoplasty (19).

In the present study, acoustic rhinometry could not show any alterations after EETSA. However, since only the values for the anterior 5 cm of the nasal cavity were assessed by acoustic rhinometry, major anatomical alterations in more posterior parts of the nasal cavity induced by the surgery could not be revealed by this test. As the data regarding objective tests in EETSA is scant, other studies may be required to better address the issue.

Conclusion

The endoscopic endonasal transsphenoidal approach for pituitary adenoma, when handled by a team including a neurosurgeon and an otolaryngologist, does not significantly change the nasal function, geometry, and sinonasal-related QOL. However, a transient objective decrease in the patency of the nasal pathway can be detected by rhinomanometry on an early postoperative evaluation that returns to baseline in the third 3rd postoperative month making the rhinomanometry the most sensitive test for alteration in nasal function after the surgery which has a good correlation with the SNOT-22 as a sinonasal QOL questionnaire.

References

1. Maroon JC. Skull base surgery: past, present, and future trends. Neurosurg Focus 2005;19(1):E1.

2. Little AS, Kelly DF, Milligan J, Griffiths C, Prevedello DM, Carrau RL, et al. Comparison of sinonasal quality of life and health status in patients undergoing microscopic and endoscopic transsphenoidal surgery for pituitary lesions: a prospective cohort study. J Neurosurg 2015; 123 (3):799-807.

3. Awad AJ, Mohyeldin A, El-Sayed IH, Aghi MK. Sinonasal morbidity following endoscopic endonasal skull base surgery. Clin Neurol Neurosurg 2015;130:162-167.

4. Little AS, Kelly D, Milligan J, Griffiths C, Prevedello DM, Carrau RL, et al. Predictors of sinonasal quality of life and nasal morbidity after fully endoscopic transsphenoidal surgery. J Neurosurg 2015;122(6):1458-1465.

5. Jalessi M, Jahanbakhshi A, Amini E, Kamrava SK, Farhadi M. Impact of nasoseptal flap elevation on sinonasal quality of life in endoscopic endonasal approach to pituitary adenomas. Eur Arch Otorhinolaryngol 2015 Jul 29. [Epub ahead of print].

6. McCoul ED, Bedrosian JC, Akselrod O, Anand VK, Schwartz TH. Preservation of multidimensional quality of life after endoscopic pituitary adenoma resection. J Neurosurg 2015;123 3):813-820.

7. Clement PA, Gordts F. standardisation committee on objective assessment of the nasal airway, IRS, and ERS. Consensus report on acoustic rhinometry and rhinomanometry. Rhinology 2005; 43 (3):169-179.

8. Ottaviano G, Lund VJ, Nardello E, Scarpa B, Frasson G, Staffieri A, et al. Comparison between unilateral PNIF and rhinomanometry in healthy and obstructed noses. Rhinology 2014; 52(1):25-30.

9. Pousti SB, Touisserkani S, Jalessi M, Kamrava SK, Sadigh N, Heshmatzade Behzadi A, et al. Does cosmetic rhinoplasty affect nose function? ISRN Otolaryngol 2011;2011:615047.

10. Mohebbi A , Farhadi M, Erfan A. Assessment of nasal volume and cross sectional area by acoustic rhinometry in a sample of normal adultIranians. Arch Iran Med 2008;11(5):555-558.

11. Morley AD, Sharp HR. A review of sinonasal outcome scoring systems - which is best? Clin Otolaryngol 2006;31(2):103-109.

12. Jalessi M, Farhadi M, Kamrava SK, Amintehran E, Asghari A, Rezaei Hemami M, et al. The reliability and validity of the Persian version of sinonasal outcome test 22 (snot 22) questionnaires. Iran Red Crescent Med J 2013;15(5):404-408.

13. Jalessi M, Sharifi G, Mirfallah Layalestani MR, Amintehran E, Yazdanifard P, RezaeeMirghaed O, et al. Sellar reconstruction algorithm in endoscopic trans-sphenoidal pituitary surgery: experience with 240 cases. Med J Islam Repub Iran 2013;27(4):186-194.

14. McCoul ED, Patel AS, Bedrosian JC, Anand VK, Schwartz TH. Intranasal cross-sectional area and quality of life changes following endoscopic transsphenoidal skull base surgery. Int Forum Allergy Rhinol 2015 Jul 22.

15. Pirilä T, Tikanto J. Acoustic rhinometry and

rhinomanometry in the preoperative screening of septal surgery patients. Am J Rhinol Allergy 2009; 23(6):605-609.

16. McCoul ED, Anand VK, Schwartz TH. Improvements in site-specific quality of life 6 months after endoscopic anterior skull base surgery: a prospective study. J Neurosurg 2012;117(3):498-506.

17. McCoul ED, Anand VK, Bedrosian JC, Schwartz TH. Endoscopic skull base surgery and its impact on sinonasal-related quality of life. Int Forum Allergy Rhinol 2012;2(2):174-181.

18. Frank G, Pasquini E, Farneti G, Mazzatenta D, Sciarretta V, Grasso V, et al. The endoscopic versus the traditional approach in pituitary surgery. Neuroendocrinology 2006;83(3-4):240-248.

19. Karatzanis AD, Fragiadakis G, Moshandrea J, Zenk J, Iro H, Velegrakis GA. Septoplasty outcome in patients with and without allergic rhinitis. Rhinology 2009;47(4):444-449.