Eur Arch Otorhinolaryngol (2013) 270:1355–1359
DOI 10.1007/s00405-012-2226-x

RHINOLOGY

Postoperative nasal symptoms associated with an endoscopic endonasal transsphenoidal approach

Boo-Young Kim · Hye Lim Son · Seok-Gu Kang · Sung Won Kim · Yong Kil Hong · Sin-Soo Jeun · Soo Whan Kim · Jin Hee Cho · Yong Jin Park

Received: 16 August 2012 / Accepted: 7 October 2012 / Published online: 19 October 2012

Abstract Recent studies have indicated the usefulness of endoscopic endonasal transsphenoidal approach (EETSA). A few studies have reported on the postoperative nasal symptoms of patients who have undergone EETSA. Therefore, we adopted a rhinologic perspective to compare preoperative and postoperative nasal symptoms after performing a binostril, four-hand EETSA. Patients who were scheduled to undergo binostril, four-hand EETSA underwent preoperative nasal evaluation using the Nasal Obstruction Symptom Evaluation (NOSE), Sino-Nasal Outcome Test-20 (SNOT-20), and a visual analogue scale (VAS) to assess several nasal symptoms. Repeat testing was performed 6 months postoperatively. Paired Student's *t* tests were used to compare preoperative and postoperative scores. A total of 142 patients who underwent a binostril, four-hand EETSA were included in this study. We found no statistically significant differences between preoperative and postoperative NOSE, total SNOT-20 scores, or scores on the VAS for nasal obstruction, sneezing, rhinorrhea, snoring, or facial pain. However, VAS of olfactory change increased significantly after EETSA ($p < 0.05$). The binostril, four-hand EETSA would be a useful method because it permits operative manipulability and a wide visual field for skull base lesions. However, rhinologists must consider postoperative nasal symptoms and perform a proper preoperative examination, especially with regard to the olfactory function, and inform patients scheduled for EETSA of potential postoperative changes.

Keywords Nasal symptom · Endoscope · Transsphenoidal approach

B.-Y. Kim · H. L. Son · S. W. Kim (✉) · S. W. Kim · J. H. Cho · Y. J. Park
Department of Otolaryngology-Head and Neck Surgery, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, 505 Banpo-dong, Seocho-gu, 137-701 Seoul, Korea
e-mail: kswent@catholic.ac.kr

S.-G. Kang · Y. K. Hong · S.-S. Jeun
Department of Neurosurgery, College of Medicine, The Catholic University of Korea, Seoul, Korea

Introduction

Since Cushing pioneered the transsphenoidal route for pituitary surgery [1], this approach has been the standard surgical treatment for sellar tumors [2], and use of the endoscopic endonasal transsphenoidal approach (EETSA) for skull base lesions has increased. EETSA has resulted in unprecedented brightness and clarity of vision combined with the unique ability to explore the tumor bed with angled views and hydroscopy. Although outcomes and complication rates are comparable to those of traditional transsphenoidal approaches, EETSA involves less dissection and tissue manipulation, and greater patient comfort and acceptance [3].

Among the delayed postoperative complications after EETSA for sellar tumors, nasal problems are frequently overlooked because most attention is paid to cranial complications such as cerebrospinal fluid leakage, meningitis, massive hemorrhage, and endocrinologic deficits. The binostril, four-hand EETSA could be considered invasive to the sinonasal cavity when compared with traditional TSA, such as the one-nostril approach. Rhinologic surgeons should preoperatively recognize and understand potential and likely postoperative outcomes and complications [4–6]. Therefore, we investigated the distinction between preoperative and postoperative nasal symptoms in patients that underwent EETSA.

Materials and methods

Between February 2009 and September 2011, 228 patients with anterior skull base tumors including pituitary adenoma underwent operation via EETSA at our tertiary university hospital. Of these, 142 were followed for at least 6 months postoperatively. The patient population included 82 males and 60 females ranging in age from 10 to 84 years. The histological diagnoses included 128 pituitary adenomas, four Rathke's cleft cyst, one meningioma, two craniopharyngiomas, two hemangiomas, one chondrosarcoma, one pseudocyst, one granular cell tumor, one xanthogranuloma and one chordoma.

The patients underwent preoperative nasal evaluation using the Nasal Obstruction Symptom Evaluation (NOSE) [7], Sino-Nasal Outcome Test-20 (SNOT-20) [8], and a visual analogue scale (VAS) addressing nasal stuffiness, sneezing, rhinorrhea, snoring, headache, facial pain, and olfactory difficulty. The NOSE and SNOT-20 provided a valuable and quantifiable quality-of-life measurement for nasal symptoms. Repeat testing was performed 6 months postoperatively.

Approval for chart review of EETSA patients was granted by the institutional review board of our university hospital. Paired Student's *t* tests were used to compare preoperative and postoperative symptom and olfactory test scores (SPSS for Windows, ver. 12.0; SPSS Inc, Chicago, IL, USA). A p value of <0.05 was considered statistically significant.

Surgical technique

Our endoscopic transsphenoidal operation was performed using a binostril, four-hand approach with an endonasal technique. The operation was performed after general anesthesia has been induced via orotracheal intubation. The patient was maintained in the supine position with the head tilted to the left and the torso elevated gently. The face and nasal vestibules were then prepared using a 5 % povidone-iodine solution. The periumbilical abdomen was prepared for the harvest of a fat graft, if needed. We utilized 4 mm sinonasal rigid endoscopes with 0° and 30° angled lenses. A lens-cleansing irrigation–suction system was used.

The nasal mucosa was decongested by local application of a decongestant solution (1:5,000 epinephrine) and an injection of lidocaine (2 %) containing epinephrine (1:100,000). The bilateral inferior turbinates were out-fractured to enhance manipulation of the endoscope and instruments, and both middle turbinates were then gently and fully lateralized to allow visualization of the superior turbinate. The superior turbinate was out-fractured to access the sphenoethmoidal recess and identify the sphenoid sinus ostium [4].

In cases with an anticipated large defect of the anterior skull base and cerebrospinal fluid leakage after surgery, we harvested a pedicled septal mucosal flap for reconstruction of the anterior skull base [9]. After elevating the right pedicled septal mucosal flap, we performed a posterior septectomy that included a portion of the perpendicular plate of the ethmoid bone, the vomer, and the anterior wall of the sphenoid sinus. During this surgical procedure, we tried to remove bony material for reconstruction of the sellar floor *en bloc*. After posterior septectomy, we identified the sellar floor. We then removed the remnant left posterior septal mucosa for a binostril, four-hand approach to the anterior skull base lesions. Mucosal bleeding was controlled with 1:100,000 epinephrine-soaked cotton pledgets and Surgicel® (Ethicon, Somerville, NJ), and major bleeding was controlled with suction electrocautery.

We reconstructed the surgical defect using a multilayer technique after tumor removal. The vomer or perpendicular plate of the ethmoid bone was placed in the bony defect as a rigid buttress in cases with cerebrospinal fluid leakage. The reflected sphenoidal sinus mucosa was repositioned to cover the operative site. The defect was covered with an absorbable hemostatic agent, such as Surgicel®. The tissue sealant DuraSeal™ (Confluent Surgical, Waltham, MA, USA) was used to secure closure of the defect. The sphenoidal sinus was obliterated with Nasopore® (Polyganics, Groningen, Netherland), an absorbable packing material. Small pieces of Merocel® (Medtronic Xomed Surgical Products, Jacksonville, FL, USA) were packed into the nasal cavity bilaterally and removed 3–5 days postoperatively.

Results

A total of 142 patients were enrolled in the study and completed the preoperative and postoperative evaluations. The mean patient age was 47 years (age range, 10–76 years). Of these patients, 82 (57 %) were men and 60 (43 %) were women.

The VAS was used to assess preoperative and postoperative nasal symptoms. It was scored from 0 to 10, with higher scores indicating more severe nasal symptoms. Baseline VAS scores were obtained at a preoperative visit and follow-up VAS scores were obtained 6 months postoperatively. We found no significant differences between mean preoperative and postoperative VAS scores for nasal obstruction (1.5 ± 2.33 vs. 1.5 ± 2; $p = 0.64$), sneezing (1.2 ± 2.15 vs. 1.45 ± 2.06; $p = 0.37$), and rhinorrhea (1.4 ± 2.44 vs. 1.58 ± 2.09; $p = 0.26$). VAS scores for olfactory change significantly worsened (0.9 ± 2.1 vs. 2.78 ± 3.89; $p = 0.000$), whereas the preoperative and postoperative VAS scores for snoring (2.5 ± 3.47 vs. 1.91 ± 2.8; $p = 0.06$) and facial pain (1.2 ± 2.27 vs. 1.04 ± 2.06;

$p = 0.53$) improved without statistical significance. And VAS scores for headache was improved significantly (2.6 ± 4.1 vs. 1.5 ± 2.38; $p = 0.004$) (Fig. 1).

The NOSE scale was scored from 0 to 20, with higher scores indicating more severe nasal obstruction. Baseline NOSE scores were obtained at a preoperative visit and follow-up NOSE scores were obtained 6 months postoperatively. We found no statistical differences between preoperative and postoperative scores (1.7 vs. 1.7; $p = 0.75$).

SNOT-20 scores were also compared descriptively by cross-tabulating the ordinal outcome (0–5) for each item and were scored from 0 to 100. Baseline SNOT-20 scores were obtained at a preoperative visit, and follow-up SNOT-20 scores were obtained 6 months postoperatively. We did not find a significant worsening in the postoperative total SNOT-20 scores (8.9 vs. 10; $p = 0.56$). Scores for most items on the SNOT-20 reflected postoperative worsening but not significantly (Table 1).

Discussion

The present study was conducted to evaluate postoperative sinonasal outcomes of patients undergoing binostril four-hand EETSA. Sinonasal symptoms were assessed using the NOSE, SNOT-20, and VAS addressing nasal stuffiness, sneezing, rhinorrhea, snoring, headache, facial pain, and olfactory difficulty. In our study, we found no statistical differences between preoperative and postoperative scores in NOSE, SNOT-20, and VAS except olfactory change. We found a significant olfactory change after binostril four-hand EETSA.

Patients undergoing EETSA experience some sinonasal morbidity in the postoperative period [8]. Sinonasal outcomes after endoscopic skull base surgery have been previously studied. Balaker et al. [8] reported the case series that specifically examined the postoperative sinonasal symptoms and outcomes of patients undergoing transnasal endoscopic skull base surgery. The results of their study using the SNOT-20 questionnaire suggest that significant sinonasal morbidity will be experienced in those patients postoperatively. However, those sinonasal symptoms showed significant improvement over time. These findings are consistent with our results.

The EETSA to the sella requires resection of the posterior aspect of the septum to gain adequate exposure and access to the sella, where the olfactory neuroepithelium is located [10]. Haruna et al. [11] evaluated patients who had undergone an endoscopic transnasal transethmosphenoidal (TTES) approach. They used a VAS to show the nasal symptoms. The scores for olfactory disturbances and nasal dryness were significantly higher with the bilateral TTES approach. In addition, Rotenberg et al. [6] reported that all patients noticed a change in olfaction and complained of olfactory dysfunction after undergoing endoscopic transsphenoidal pituitary surgery. The results of their studies coincide well with our results. Hart et al. [4] reported the patients undergone transnasal endoscopic resection of a pituitary lesion had transient olfactory dysfunction before 3 months after surgery. They used the University of Pennsylvania Smell Identification Test (UPSIT) and middle turbinate preserving operative technique. However, their study was a short-term follow-up and did not describe the exact surgical procedures, such as binostril or one-nostril approach, whether the nasoseptal flap was used or not.

Multiple possible explanations have been proposed for this worsening of olfactory function, such as postoperative scarring, mucosal edema, alterations of aerodynamic patterns toward or within the olfactory cleft, and unrecognized resection of the olfactory epithelium [6]. Development of a technique to decrease injury to the posterior-superior area

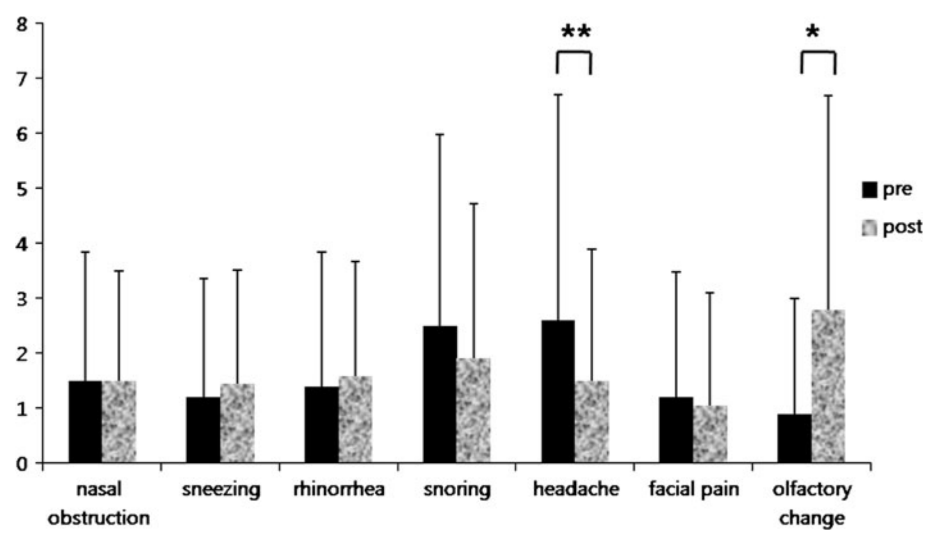

Fig. 1 Comparison of preoperative and postoperative nasal symptoms using a VAS. Baseline VAS scores were obtained at a preoperative visit, and follow-up VAS scores were obtained 6 months postoperatively. Olfactory functions (3.61 vs. 8.57; $p = 0.00$) showed significant worsening postoperatively (*). Headache improved significantly (**)

Table 1 SNOT-20 score for each questionnaire items (Q1–Q20)

Item	Time point			Item	Time point		
	Statistic	Pre	Post		Statistic	Pre	Post
Q1	Mean (SD)	0.75 (0.9)	0.75 (1)	Q11	Mean (SD)	0.47 (0.73)	0.51 (1.25)
	p value	0.263			*p* value	0.8	
Q2	Mean (SD)	0.65 (0.9)	0.66 (0.9)	Q12	Mean (SD)	0.41 (0.83)	0.58 (1.03)
	p value	0.16			*p* value	0.08	
Q3	Mean (SD)	0.58 (0.99)	0.56 (0.86)	Q13	Mean (SD)	0.39 (0.64)	0.66 (1.17)
	p value	0.49			*p* value	0.24	
Q4	Mean (SD)	0.29 (0.69)	0.3 (0.71)	Q14	Mean (SD)	68 (0.91)	0.77 (1.01)
	p value	0.15			*p* value	0.92	
Q5	Mean (SD)	0.39 (0.85)	0.48 (0.82)	Q15	Mean (SD)	0.9 (1.08)	0.85 (0.97)
	p value	0.14			*p* value	0.67	
Q6	Mean (SD)	0.23 (0.59)	0.33 (0.78)	Q16	Mean (SD)	0.47 (0.86)	0.64 (0.95)
	p value	0.21			*p* value	0.27	
Q7	Mean (SD)	0.19 (0.61)	0.25 (1.59)	Q17	Mean (SD)	0.48 (0.89)	0.58 (0.87)
	p value	0.14			*p* value	0.21	
Q8	Mean (SD)	0.34 (0.81)	0.38 (0.77)	Q18	Mean (SD)	0.41 (0.88)	0.51 (0.95
	p value	0.31			*p* value	0.11	
Q9	Mean (SD)	0.15 (0.63)	0.14 (0.53)	Q19	Mean (SD)	0.41 (0.24)	0.41 (0.8)
	p value	0.38			*p* value	0.24	
Q10	Mean (SD)	0.35 (0.8)	0.19 (0.5)	Q20	Mean (SD)	0.3 (0.64)	0.35 (0.73)
	p value	0.22			*p* value	0.08	

Simple summary statistics at each time point. Baseline SNOT-20 scores were obtained at a preoperative visit, and follow-up SNOT-20 scores were obtained 6 months postoperatively

There were no significant differences in any items

Q1, need to blow nose; Q2, sneezing; Q3, runny nose; Q4, cough; Q5, postnasal discharge; Q6, thick nasal discharge; Q7, ear fullness; Q8, dizziness; Q9, ear pain; Q10, facial pain/pressure; Q11, difficulty falling asleep; Q12, wake up at night; Q13, lack of a good night's sleep; Q14, wake up tired; Q15, fatigue; Q16, reduced productivity; Q17, reduced concentration; Q18, frustrated/restless/irritable; Q19, sad; Q20, embarrassed

Pre preoperative, *Post* postoperative, *SD* standard deviation

of the nasal septum and superior turbinate in which the olfactory epithelium is distributed prevents olfactory dysfunction. This could preserve quality of life including olfaction in the patients undergone binostril four-hand EETSA.

We also found improvement between preoperative and postoperative VAS scores for headache. Among SNOT-20 items, Q10: facial pain and Q15: fatigue were improved without significance. We may have explained that headache and facial pain were subsided because of removal of tumor in skull base. The VAS score for snoring improved. The volume of inspired air may have increased postoperatively, leading to subjective improvements in snoring among EETSA patients. We are planning to obtain information on changes in airflow through an inspiration model of EETSA patients. This information may help to evaluate and treat patients who snore after EETSA.

Our study has several advantages. First, we studied a relatively large number of patients compared with previously published studies. We also followed the patients for at least 6 months. Second, we attempted to evaluate all changes in nasal symptoms. The patients scheduled for EETSA understood the postoperative nasal symptoms because they were informed of expected changes in nasal symptoms. We also confirmed practical changes through pre- and postoperative self-report surveys addressing nasal symptoms. However, our study may have some inherent weaknesses. We used only one time point (6 months postoperatively) for follow-up. Thus, we could not investigate changes in nasal symptoms after 6 months. However, a 6-month follow-up is a relatively long period of time. Therefore, we could reasonably explain the predicted nasal problems beforehand.

Conclusion

In conclusion, to avoid extracranial nasal problems after EETSA, rhinologic surgeons should pay careful attention to meticulous manipulation of the intranasal structures, including the olfactory neuroepithelium. To this end, nasal function tests including olfaction are also essential. Rhinologists should also be reminded of the need for careful postoperative management of the nasal cavity after surgery. An endoscopic binostril four-hand EETSA may increase the extent of injury to nasal structures; consequently, we should inform patients scheduled for EETSA about postoperative nasal symptoms especially in olfactory change.

Acknowledgments This research was supported by Seoul St. Mary's Clinical Medical Research Program year of 2010 through the Catholic University of Korea.

Conflict of interest None.

References

1. Rosegay H (1981) Cushing's legacy to transsphenoidal surgery. J Neurosurg 54:448–454
2. Adams CB, Burke CW (1993) Current modes of treatment of pituitary tumors. Br J Neurosurg 7:123–128
3. Senior BA, Ebbert CS, Bednarski KK et al (2008) Minimally invasive pituitary surgery. Laryngoscope 118:1842–1855
4. Hart CK, Theodosopoulos PV, Zimmer LA (2010) Olfactory changes after endoscopic pituitary tumor resection. Otolaryngol Head Neck Surg 142:95–97
5. Orlandi RR, Lanza DC, Bolger WE, Cleriico DM, Kennedy DW (1999) The forgotten turbinate: the role of the superior turbinate in endoscopic sinus surgery. Am J Rhinol 13:251–259
6. Rotenberg BW, Saunders S, Duggal N (2011) Olfactory outcomes after endoscopic transsphenoidal pituitary surgery. Laryngoscope 121:1611–1613
7. Ahn JH, Lee BJ, Kim JH, Kim YJ (2000) Postoperative Nasal Symptoms after Transseptal Transsphenoidal Hypophysectomy. Korean J Otolaryngol 43:520–522
8. Balaker AE, Bergsneider M, Martin NA, Wang MB (2010) Evolution of sinonasal symptoms following endoscopic anterior skull base surgery. Skull Base 20:245–251
9. Zanation AM, Carrau RL, Synderman CH et al (2009) Nasoseptal flap reconstruction of high flow intraoperative cerebral spinal fluid leaks during endoscopic skull base surgery. Am J Rhinol Allergy 23:58–521
10. Dorty RL (2001) Olfaction. Annu Rev Psychol 52:423–452
11. Haruna S, Otori N, Moriyama H, Kamio M (2007) Endoscopic transnasal transethmosphenoidal approach for pituitary tumors: assessment of technique and postoperative findings of nasal and paranasal cavities. Auris Nasus Larynx 34:57–63