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Olfactory changes after endoscopic sinus surgery in patients with chronic rhinosinusitis

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ABSTRACT

Objective: To address the controversy over whether olfactory function is improved or not after endoscopic sinus surgery (ESS) in patients with eosinophilic (ECRS) and non-eosinophilic chronic rhinosinusitis (non-ECRS).

Methods: Between June 2006 and March 2012, 89 adult patients with CRS underwent ESS at Hyogo College of Medicine. There were 55 men and 34 women with a mean age of 53 years old, ranging from 23 to 79 years. The average follow-up period was 10.7 months (3–24) after ESS. Peripheral blood examination, sinonasal CT imaging, and four kinds of olfaction tests [self-administered olfaction test (SAOQ), visual analog scale (VAS), T&T recognition threshold tests (T&T) and intravenous olfaction test using prosultiamine] were performed. We diagnosed ECRS when (i) symptoms of nasal congestion and olfactory disorder, (ii) bilateral chronic rhinosinusitis with nasal polyps (CRSwNPs), (iii) peripheral blood eosinophilia (>7.0%), and (iv) ethmoid sinus dominant opacification in preoperative CT findings (i.e. ethmoid sinuses (E) were more bilaterally occupied than those of maxillary sinuses (M), E/M $\geq$ 1), were completely fulfilled. We divided the patients into two groups of ECRS (group A) and non-ECRS (group B). Olfaction tests before operation, and at the 3rd, 6th, 12th, and 24th month postoperation were analyzed. The severity and therapeutic evaluation of olfaction were based on criteria of T&T recognition thresholds.

Results: The mean SAOQ and VAS scores showed significant improvement within 6 months after ESS in both group A and group B. In total, the improvement rates were 52.0% (26/50) at 3 months, 58.5% (24/41) at 6 months, 40.5% (15/37) at 12 months, and 41.2% (7/17) at 24 months. The significant improvement of T&T recognition thresholds in group B was maintained for 24 months, whereas those in group A, showing transient improvement, deteriorated after 12 months or more. A significant difference in postoperative T&T recognition between groups A and B was found at the 12th postoperative month. In both A and B, 84% of patients had a response to prosultiamine (positive group) in the preoperative stage. T&T thresholds in the positive group were significantly better that those in the negative groups in the postoperative stage.

Conclusion: Olfactory disorders due to ECRS showed transient improvement that deteriorated as time passed after surgery. The olfaction in the non-ECRS patients recovered comparatively well. Postoperative olfactory results were unfavorable in patients without a preoperative reaction to prosultiamine.

1. Introduction

Olfactory disorders are common symptoms in ENT clinics, and impair quality of life. Rhinosinusitis is thought to be a common pathogenesis among patients with olfactory disorders [1]. Chronic rhinosinusitis (CRS), a heterogeneous disease, has recently been divided into two subgroups: chronic rhinosinusitis with nasal polyps (CRSwNP) and chronic rhinosinusitis without nasal polyps (CRSsNP) in Europe and the United States [2]. The majority of patients with CRSwNP are thought to exhibit recurrence after surgery. In Japan, refractory CRSwNP with eosinophil-dominant inflammation was reported as "eosinophilic chronic rhinosinusitis" (ECRS) in 2001 [3]. Symptoms of nasal obstruction and olfactory disorder are commonly observed in patients with ECRS. Olfactory disorder particularly appears in the early stages [4]. It is difficult to improve such symptoms completely and to maintain a good condition for a long time with conservative management alone. Endoscopic sinus surgery (ESS) is an important first-line

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treatment for ECRS [4]. However, there remains some controversy as to whether olfactory function is improved or not after ESS in patients with ECRS [5–9].

The purpose of this study was to clarify the postoperative changes of olfactory acuity in patients with CRS. To precisely assess the olfactory function in detail, we divided the patients into a group of ECRS patients who were definitely diagnosed and another group of non-ECRS. Differences in time-series olfactory changes in ECRS and non-ECRS patients were investigated and discussed.

2. Materials and methods

2.1. Patients and diagnosis

Between June 2006 and March 2012, 89 adult patients suffering from olfactory disorders with CRS underwent ESS at the Department of Otolaryngology, Hyogo College of Medicine. ESS and olfaction tests were performed in all patients after obtaining appropriate informed consent. Only patients whose olfactory acuities were evaluated both before and after their operation were analyzed in this study. There were 55 men and 34 women. The mean age was 52.2 years with a range from 22 to 79 years. Bronchial asthma was a complication in 26 patients (29%), and 10 of them had aspirin-induced asthma (AIA). The average follow-up period was 10.7 months (3–24 months) after ESS.

In this study, we divided the subjects into two groups (A and B): group A consisted of patients diagnosed as ECRS; and group B consisted of patients who did not fulfill the criteria of ECRS (Table 1). We diagnosed ECRS according to previous reports when all the following conditions were completely fulfilled (i–iv): (i) symptoms of olfactory disorder; (ii) bilateral chronic rhinosinusitis with nasal polyps (CRSwNPs); (iii) peripheral blood eosinophilia (>7.0%); and (iv) bilateral ethmoid sinus-dominant opacification in preoperative CT findings, in other words, the ethmoid (E) sinuses were equally or more occupied than the maxillary (M) sinuses ($E/M \geq 1$) according to the Lund-Mackay scoring system [3,4,10]. Group A consisted of 38 patients, and the remaining 51 patients were in group B (Table 1).

2.2. Surgical and postoperative treatments

Bilateral ESS was performed on all patients by three surgeons under general anesthesia. After nasal polypotomy, sinus surgery including uncinectomy, removal of bulla ethmoidalis, middle meatal antrostomy, surgery of frontal sinus, and sphenoidotomy were performed. For the treatment at olfactory clefts, the superior nasal meatus was completely opened to remove obstructing polyps and consequently enable more intranasal airflow [11]. Intraoperative endoscopic findings of mucosae at the olfactory clefts were recorded as normal, edema, and polyp. Powered inferior turbinoplasty and endoscopic septoplasty were additionally performed on 74 patients for correction of the nasal cavity. After ESS, no complications except for mild postoperative bleeding were observed in the hospital. Penicillin-based antibiotics were intravenously administered for two days. The patients remained in hospital for several days.

Table 1
Profiles of this study ($n = 89$).

	Group A ECRS ($n = 38$)	Group B non-ECRS ($n = 51$)
Age	50.9 years (23–74)	53.2 years (22–79)
Gender	22 men, 16 women	33 men, 18 women
Asthma (AIA)	21 patients (7)	4 patients (3)
Percentage of eosinophil	9.5% (7.1–15.9)	4.7% (0.6–19.2)
Follow-up period	9.8 months (3–24)	11.3 months (3–24)

After discharge from hospital, patients were treated endoscopically with debridement and lavage once a week for the first postoperative month as outpatients. After the second month, patients were treated once a month until 3 months. After 3 months, the nasal treatments and olfaction tests were principally performed every 3 months. When polypous swollen mucosae were observed, celestamine combination tablet®, which contains betamethasone (0.25 mg) and D-chlorpheniramine maleate (2 mg) (Merck & Co., Inc., Tokyo, Japan), was orally administered daily for one or two weeks. For patients suffering from nasal symptoms and polyps despite this treatment, prednisolone at a dose of 10–20 mg a day was orally administered for a week after receiving sufficient informed consent regarding side effects induced by steroids. Mucolytics and/or anti-allergic agents were additionally administered.

2.3. Evaluation of olfaction

In this study, four kinds of olfaction test were performed in all patients before and after the ESS (1–4): (1) self-administered odor questionnaire (SAOQ) [12]; (2) visual analog scale (VAS) [13]; (3) T&T olfactometer recognition threshold test (T&T test); and (4) intravenous olfaction test using prosultiamine.

To analyze postoperative time series variations of olfactory acuity, the olfaction tests were performed on an outpatient basis at 3, 6, 12, and 24 months after ESS for as long as possible. The postoperative olfactory changes were also tested in 22 patients at 3 months, 19 at 6 months, 10 at 12 months, and 7 patients at 24 months after ESS. In group B, olfaction tests at 3, 6, 12, and 24 months after ESS were conducted for 28, 22, 27, and 10 patients, respectively.

2.3.1. SAOQ (self-administrated odor questionnaire)

The SAOQ was proposed as an easy method for measuring olfaction by the Japan Rhinology Society. The SAOQ was described in detail in our previous report [12]. The SAOQ consists of 20 smell-related items: "*steamed rice, miso, seaweed, soy sauce, baked bread, butter, curry, garlic, orange, strawberry, green tea, coffee, chocolate, household gas, garbage, timber, sweat, stool, flower, and perfume*", by referring to odors in some olfaction tests and odor analysis. Patients marked each odor item as one of four levels: two points when they could smell the odor strongly; one point when they could smell the odor weakly; zero points when they could not smell it at all; or "unknown" (without any points). Patients answering "unknown" for more than 11 items were excluded from the analysis in this study. The SAOQ score (%), which is the proportion of the total score for each item compared with the maximum score, was calculated. The SAOQ score of a normal reference level is thought to be 70% or more (≥70) [12].

2.3.2. VAS (visual analog scale)

We also applied olfactory VAS, another instant self-administered olfaction test, consisting of a 10 cm linear scale that indicates the degree of patients' subjective olfaction from "anosmia" (0%) on the far left to "normosmia" (100%) on the far right [13]. The VAS score (%), which is the distance to the point that patients checked on the line, was calculated.

2.3.3. T&T test (T&T olfactometer recognition threshold test)

T&T test consists of five odorants: (A) β-phenyl ethyl alcohol, which smells like a rose; (B) methyl cyclopentenolone, which smells like burning; (C) iso-valeric acid, which smells like sweat; (D) γ-undecalactone, which smells like fruit; and (E) skatole, which smells like garbage (Takasago Industry, Tokyo, Japan). Examinations were performed by one clinical laboratory technician to limit examiner bias. Both detection (○) and recognition (×) thresholds for each odorant were obtained and averaged [14].