

Exploring and Analyzing the Application Value of Endoscopic Nasal Septum Deviation Correction Combined with Low-Temperature Plasma Radiofrequency Ablation in the Treatment of Chronic Sinusitis

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Abstract: *Objective:* To explore the clinical efficacy and application value of endoscopic nasal septum deviation correction combined with low-temperature plasma radiofrequency ablation in the treatment of chronic sinusitis. *Methods:* Among the patients with chronic sinusitis admitted to our hospital, 70 patients admitted from January 2023 to January 2025 were selected as the observation subjects. All patients underwent endoscopic nasal septum deviation correction surgery and were divided into two groups based on the order of admission. The first 35 patients admitted were designated as the control group and underwent combined endoscopic sinus surgery. The latter 35 patients admitted were designated as the observation group and underwent combined low-temperature plasma radiofrequency ablation. The postoperative nasal mucosal function, olfactory function, airway reactivity, and occurrence of complications were observed in both groups to evaluate the therapeutic efficacy. *Results:* (1) Nasal mucosal function. The observation group had a shorter postoperative saccharin clearance time compared to the control group ($P < 0.05$). The nasal mucociliary clearance rate was higher in the observation group than in the control group ($P < 0.05$). (2) Olfactory function. The olfactory function grading in the observation group was superior to that in the control group ($P < 0.05$). (3) Airway reactivity. The observation group exhibited lower postoperative airway resistance at 5 Hz and 20 Hz compared to the control group ($P < 0.05$). Additionally, the resonance frequency was lower in the observation group than in the control group ($P < 0.05$). (4) The incidence of complications was similar between the two groups ($P > 0.05$). (5) The total therapeutic efficacy rate in the observation group was superior to that in the control group ($P < 0.05$). *Conclusion:* Endoscopic nasal septum deviation correction combined with low-temperature plasma radiofrequency ablation in the treatment of patients with chronic sinusitis can promote the recovery of nasal mucosal function, improve olfactory function, alleviate airway reactivity, and demonstrate good safety and significant therapeutic efficacy.

Keywords: Endoscopic correction of nasal septum deviation; Low-temperature plasma radiofrequency ablation; Chronic sinusitis; Clinical efficacy

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1. Introduction

Chronic sinusitis is a common nasal disease in clinical practice, commonly known as rhinitis. After its onset, it can affect the patient's nasal cavity condition and olfactory function. From a pathological perspective, it is a chronic inflammatory lesion with strong heterogeneity. Moreover, most cases of chronic sinusitis are accompanied by nasal septum deviation. When both conditions coexist, they interact with each other, exacerbating the severity of the illness. Currently, the primary treatment for chronic sinusitis is medication control, which only addresses the symptoms rather than the root cause. As the condition recurs, it can have a significant negative impact on the patient's physical and psychological well-being. Under such circumstances, clinical practice advocates for the treatment of chronic sinusitis accompanied by nasal septum deviation using endoscopic nasal surgery. Among these, nasal septum correction combined with sinus surgery is relatively common and yields acceptable results. During surgery, measures such as cryotherapy, laser, microwave, and electrocautery may be employed to shape the inferior turbinate. Different treatment measures result in varying degrees of trauma to the patient. If an inappropriate approach is chosen, it may lead to larger wounds, hindering the recovery of nasal mucosal function and increasing the likelihood of complications. With the continuous advancement of medical technology, low-temperature plasma radiofrequency ablation has also become increasingly mature. As a minimally invasive procedure, it can minimize trauma to the patient's nasal cavity while treating the diseased tissue, thereby preventing postoperative complications. Its principle involves using radiofrequency energy to vaporize and ablate the diseased tissue under low-temperature conditions to achieve therapeutic goals. This study observed 70 patients who underwent endoscopic correction of nasal septum deviation surgery at our hospital from January 2023 to January 2025, exploring the efficacy of combining it with low-temperature plasma radiofrequency ablation. The report is as follows.

2. General information and methods

2.1. General information

Among the patients with chronic sinusitis admitted to the hospital, 70 cases admitted from January 2023 to January 2025 were selected as the observation subjects. All patients underwent nasal endoscopic surgery for the correction of a deviated nasal septum. Based on the order of admission, they were divided into two groups.

The first 35 patients admitted constituted the control group, consisting of 19 males and 16 females, aged between 24 and 62 years old, with an average age of (45.29 ± 7.12) years old. The disease grading was as follows: 16 cases of Type I, 12 cases of Type II, and 7 cases of Type III. Among the 35 patients admitted later, serving as the control group, there were 18 males and 17 females, aged between 23 and 65 years old, with an average age of (45.72 ± 7.41) years old. The lesion grading was as follows: 15 cases of Type I, 13 cases of Type II, and 7 cases of Type III. A comparison of the basic data of the two groups of patients determined that $P > 0.05$.

2.2. Inclusion and exclusion criteria

Inclusion criteria: (1) Meeting the diagnostic criteria for chronic sinusitis upon examination^[1]; (2) Meeting the criteria for surgical treatment; (3) Having undergone conservative treatment for more than 6 months with poor efficacy; (4) Patients and their families have signed an informed consent form.

Exclusion criteria: (1) Presence of other infectious diseases or coagulopathy; (2) Previous nasal surgery; (3) Presence of other nasal pathologies; (4) Presence of malignant tumors or organic defects.

2.3. Methodology

After determining the surgical schedule, the patient's nasal cavity was cleaned preoperatively, including routine trimming of nasal hair and nasal cleansing.

Control group: Nasal endoscopic surgery for the correction of deviated nasal septum + nasal endoscopic sinus surgery. Tracheal intubation was performed under general anesthesia. A 1% tetracaine cotton pad (containing 1%

epinephrine) was inserted into the top, bottom, and middle meatus of the nasal cavity to constrict the nasal mucosa. Under nasal endoscopy, an L-shaped incision was made, the left mucoperichondrium and mucoperiosteum were dissected, and then the nasal septum cartilage was incised. The procedure is performed on the right side, where the connection between the cartilage and the perpendicular plate of the ethmoid bone is severed, and the cartilage is incised. The deviated tissue is then bitten off to observe the correction status. If satisfactory, the mucosa can be repositioned and sutured. After correcting the deviation, endoscopic sinus surgery, specifically bilateral inferior turbinate fracture and lateralization, is performed. A nasal septum scissor is used to remove a portion of the inferior turbinate, not exceeding one-third, followed by bipolar electrocoagulation for hemostasis. Gauze is applied to the wound surface of the inferior turbinate to achieve hemostasis. Postoperatively, the patient's middle meatus is symmetrically packed with highly expansive sponges.

Observation group: Endoscopic nasal septoplasty combined with low-temperature plasma radiofrequency ablation. The endoscopic nasal septoplasty procedure is essentially the same as that in the control group. After completion, under endoscopic guidance, surgical points on the inferior turbinate are selected, typically 3 to 4 reduction points, with targeted plasma energy settings. Ablation therapy is performed along the inferior turbinate, at a distance of approximately 0.5 to 0.8 cm beneath the mucosa. Each ablation point is treated for 6 to 8 seconds. If the therapeutic effect is unsatisfactory after the initial ablation, a second ablation is required after 15 days. Similarly, after the surgery, the middle meatus is packed with highly expansive sponges.

Prognosis: For both groups, the condition inside the nasal cavity should be observed 48 hours postoperatively. If no abnormalities are found, the packing sponges can be removed. Nasal irrigation can be performed 72 hours postoperatively. Within three months post-surgery, patients are guided to return to the hospital weekly for follow-up and endoscopic cleaning to ensure recovery effectiveness.

2.4. Evaluation indicators

- (1) Nasal mucosa function: The primary indicators include saccharin clearance time, mucociliary clearance rate, and nasal mucociliary clearance rate. Saccharin test method: Place saccharin on the turbinate (1.0 cm from the head end), and have the patient swallow every 30 seconds until they taste sweetness. Record the time. One hour after the sweetness completely disappears in the mouth, perform the test on the other side and obtain the average value.
- (2) Olfactory function: The T&T olfactory test was employed to rate patients' olfactory function, with grading ranging from I to V. Test procedure: Five different odorants, phenylethyl alcohol, isovaleric acid, trimethylindole, methylcyclopentenone, and undecanolactone, were selected and sequentially diluted into five concentration gradients, increasing tenfold each time, with scores ranging from low to high (1–5 points). Functional grading was based on the olfactory recognition threshold^[2]. A score of ≤ 1.0 indicates Grade I; scores between 1.1 and 2.5 indicate Grade II; scores between 2.6 and 4.0 indicate Grade III; scores between 4.1 and 4.9 indicate Grade IV; and a score of 5.0 indicates Grade V. Higher scores indicate poorer olfactory function.
- (3) Airway reactivity: A pulmonary function tester was used for detection, recording resonant frequency, airway resistance at 5 Hz, and airway resistance at 20 Hz.
- (4) Complications: Conditions such as nasal dryness and epistaxis were recorded.
- (5) Efficacy: Cure was defined as the disappearance of purulent nasal discharge, normal sinus ostium, complete resolution of clinical symptoms, and improvement of at least 90% in all functions compared to pre-treatment levels. Marked effectiveness was defined as alleviation of clinical symptoms, reduction in purulent discharge, and improvement of 65% to 89% in all functions compared to pre-treatment levels. Effectiveness was defined as partial improvement in symptoms and improvement of 30% to 64% in all indicators compared to pre-treatment levels. Ineffectiveness was defined as failure to meet the aforementioned criteria.

2.5. Statistical analysis

Data were analyzed using the statistical software SPSS 18.0. Continuous variables were expressed as mean $\pm$ standard

deviation (SD) and analyzed using the *t*-test. Categorical variables were expressed as rates (%) and analyzed using the χ^2 test. A *P*-value of < 0.05 was considered statistically significant.

3. Results

(1) Nasal mucosa function

In terms of the postoperative saccharin clearance time, the observation group's (14.65 ± 1.34) min was shorter than the control group's (16.78 ± 2.42) min, with a significant difference ($P < 0.05$). Regarding the nasal mucociliary clearance rate and nasal mucociliary transport rate, the observation group's (9.52 ± 0.82) mm/min and (88.66 ± 4.72) mm/min were higher than the control group's (8.66 ± 0.72) mm/min and (80.81 ± 5.67) mm/min, respectively, with significant differences ($P < 0.05$).

(2) Olfactory function

Before surgery, in the observation group, the olfactory function grades I, II, and III were 7 cases (20.00%), 17 cases (48.57%), and 11 cases (31.43%), respectively. In the control group, the olfactory function grades I, II, and III were 8 cases (22.86%), 15 cases (42.86%), and 12 cases (34.29%), respectively. The comparison between the two groups was generally consistent ($P > 0.05$). After treatment, the observation group had 23 cases (65.71%) with grade I olfactory function, 12 cases (34.29%) with grade II, and 0 cases with grade III. The control group had 15 cases (42.86%) with grade I, 17 cases (48.57%) with grade II, and 3 cases (8.57%) with grade III. It can be seen that the postoperative olfactory function grading in the observation group was superior to that in the control group ($P < 0.05$).

(3) Airway reactivity

In terms of the postoperative airway resistance at 5 Hz and 20 Hz, the observation group's (4.11 ± 0.76) kPa/(L·S) and (2.03 ± 0.33) kPa/(L·S) were both lower than the control group's (5.21 ± 0.76) kPa/(L·S) and (2.67 ± 0.31) kPa/(L·S), respectively, with significant differences ($P < 0.05$). Regarding the postoperative resonant frequency, the observation group's (10.82 ± 2.17) Hz was lower than the control group's (12.53 ± 1.82) Hz, with a significant difference ($P < 0.05$).

In the observation group, there were 3 cases of nasal dryness and 1 case of nasal bleeding. In the control group, there were 3 cases of nasal dryness and 2 cases of nasal bleeding. The incidence of complications in the observation group was 11.43%, which was generally consistent with the control group's 14.29% ($P > 0.05$).

In the observation group, 16 cases were cured, 15 cases showed marked improvement, 3 cases were effective, and 1 case was ineffective; in the control group, 10 cases were cured, 11 cases showed marked improvement, 8 cases were effective, and 6 cases were ineffective. The total effective rate of treatment in the observation group was 97.14%, which was superior to the 82.86% observed in the control group, with a significant difference ($P < 0.05$).

4. Discussion

Chronic sinusitis is a chronic inflammatory disease with a relatively high clinical incidence, characterized by recurrence, a long disease course, and difficulty in achieving a cure. It is typically caused by infection, with the primary pathological mechanism being long-term local inflammatory stimulation of the mucosa^[3]. During an episode, various pathological changes occur, including mucosal edema, hyperplasia, and enlargement of the nasal concha, and impaired drainage of the sinuses. Typically, patients with chronic sinusitis experience clinical symptoms such as nasal congestion, reduced sense of smell, and nasal discharge. In some cases, these symptoms are accompanied by dizziness and fatigue, limiting daily life and work. Additionally, with recurrent episodes, negative emotions may gradually develop in patients. Deviated nasal

septum refers to a morphological change in the nasal septum, where it becomes deformed and protrudes to one or both sides. This condition significantly interferes with nasal function, leading to phenomena such as nasal obstruction and, in severe cases, impaired drainage of the sinuses, resulting in inflammatory lesions. In practice, most patients with chronic sinusitis also have a deviated nasal septum, and the severity of both conditions mutually influences each other. Therefore, treatment should not be limited to addressing only one of these conditions.

Currently, medication is commonly used for treating chronic sinusitis, either in the form of oral anti-inflammatory drugs or sprays. The primary principles of these medications include anti-inflammatory, anti-allergic, and improving nasal mucosal ciliary function. However, their effectiveness is often unsatisfactory. With further research, clinical practice now advocates for surgical treatment of patients with chronic sinusitis. With the widespread adoption of nasal endoscopic technology, nasal endoscopic sinus surgery has become quite common. This surgical approach can better alleviate nasal congestion symptoms in patients, promoting ventilation and ciliary transport functions, and relieving mucosal inflammation. However, sinus surgery involves significant trauma and can have a considerable impact on nasal mucosal function. Naturally, the surgical approach also requires careful consideration. Furthermore, most patients exhibit nasal septum deviation. Simply improving the condition of the paranasal sinuses cannot guarantee therapeutic efficacy. Based on this, clinical practice often necessitates prioritizing endoscopic correction of nasal septum deviation, complemented by a reasonable intervention plan for the paranasal sinuses to ensure therapeutic efficacy. The principle of low-temperature plasma radiofrequency ablation is as follows: utilizing radiofrequency energy to excise lesions at a relatively low temperature. Throughout the process, submucosal tissue proteins can also be coagulated, leading to their denaturation and atrophy, generally achieving the treatment objective^[4].

During the operation, the temperature is controlled at around 50°, ensuring that other mucosal tissues in the patient's nasal cavity are hardly affected, and postoperative complications can also be mitigated. In this study, all 70 patients with chronic sinusitis underwent endoscopic nasal septum deviation correction. The control group underwent conventional endoscopic sinus surgery in addition, while the observation group received low-temperature plasma radiofrequency ablation. By comparing the postoperative olfactory and mucosal functions of the two groups, it can be observed that the observation group held an advantage over the control group. Conventional endoscopic sinus surgery causes significant damage to the nasal mucosa during the procedure and can easily affect the nasal anatomical structure, increasing surgical difficulty. In particular, posterior excision increases the use of packing materials, exacerbates damage, and complicates prognosis, leading to slow recovery of various functions. In contrast, low-temperature plasma radiofrequency ablation effectively circumvents this issue by minimizing mucosal damage when treating submucosal hyperplastic tissue. It offers safety when addressing posterior hyperplastic tissue and can create and maintain the hierarchical, morphological, and structural integrity of nasal tissues, fostering an environment more conducive to the recovery of related functions^[5].

5. Conclusion

In conclusion, treating patients with chronic sinusitis using endoscopic correction of nasal septum deviation combined with low-temperature plasma radiofrequency ablation can promote the recovery of nasal mucosal function, improve olfactory function, alleviate airway reactivity, and offer good safety and significant therapeutic efficacy.

Disclosure statement

The authors declare no conflict of interest.

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