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MAIN ARTICLE

Meticulous endoscopic sinus surgery to prevent recurrence of massive nasal polyposis

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Abstract

Objective: To evaluate the effect of meticulous endoscopic surgery, including opening of all involved sinus cells, on the subsequent symptoms and endoscopic findings of patients with massive nasal polyposis.

Study design and method: One hundred patients with massive nasal polyposis resistant to medical treatment were selected. We documented each patient's demographic data, associated diseases, endoscopic findings, Lund–Mackay score and Sino-Nasal Outcome Test 22 (SNOT22) symptom score. All patients were followed up for at least two years to evaluate any recurrence.

Results: Of the 100 patients, 20 per cent had a history of asthma and 27 per cent had undergone previous surgery. All underwent endoscopic sinus surgery. After two years of follow up, 8 per cent had recurrence requiring surgery. Recurrence was significantly associated with a history of asthma ($p < 0.001$) and the histopathological presence of eosinophilia ($p = 0.014$).

Conclusion: Meticulous endoscopic opening of all involved sinus cells can be a safe and effective means of controlling massive nasal polyposis, with an acceptable recurrence rate.

Key words: Nasal Polyps; Sinusitis; Asthma; Endoscopic Surgery; Prognosis

Introduction

Nasal polyposis is a common sinus disease occurring in 1 to 4 per cent of the general population.[1] It can affect various aspects of patients' health, and can significantly reduce quality of life.[2,3]

Despite the relatively high prevalence of this condition, its exact aetiology is unclear.[4] The presence of asthma, aspirin sensitivity or cystic fibrosis may increase the risk of recurrence.[1,5,6]

Despite much research, nasal polyposis is still considered a difficult condition to treat.[7] Nowadays, functional endoscopic sinus surgery is considered standard treatment.[8,9] However, over the years different interventions have been used in an attempt to improve treatment outcomes, with varying success.[4,10] Currently, massive nasal polyposis has a recurrence rate of approximately 50 per cent.[10,11]

The outcome of nasal polyposis surgery is affected by various prognostic factors, which have not been thoroughly evaluated.[1,9,12]

However, the method of surgery is known to be an important factor. Minimally invasive surgery and cephalisation are the two most common methods, and each has its advocates. However, many reports state that incomplete opening of all involved sinus cells plays a key role in the failure of primary surgery.[13] Thus, many authors emphasise the importance of meticulous endoscopic surgery to remove all active areas of the condition.[14,15]

The present study evaluated the effect of meticulous endoscopic surgery, with opening of all involved sinus cells, on the symptoms and endoscopic findings of patients with massive nasal polyposis.

Subjects and methods

Subjects

We selected for the study 100 consecutive patients with a history of massive nasal polyposis resistant to maximal medical treatment (i.e. at least four weeks of broad spectrum antibiotic therapy in addition to nasal corticosteroid, guaifenesin and nasal saline douches) who were candidates for endoscopic sinus surgery. The patients were selected from among those attending the rhinology clinic of a tertiary referral centre (the Imam Khomeini Hospital, Tehran). All patients were followed up for at least two years after surgery. The study began in January 2007 and finished in March 2010.

Inclusion criteria. The diagnosis of massive nasal polyposis was based on history, imaging and endoscopic

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findings. Sinusitis patients were selected after at least six weeks of maximal medical treatment. All patients had a Lund–Mackay score of at least 16.

Exclusion criteria. None of our patients suffered from systemic diseases (e.g. sarcoidosis or Wegener's granulomatosis) or psychological problems. None were taking medications which interfered with post-operative treatment of nasal polyposis. We excluded pregnant patients, those younger than 18 years, and those with immunodeficiency, neoplasia or fungal rhinosinusitis. Two patients who did not complete the follow-up period were excluded from the study, leaving a study population of 100 out of 102 initially selected patients. The two patients lost to follow up did not have more complications than the other patients, and their characteristics did not affect the final outcome.

Ethical approval

The protocol of this study was approved by the Institutional Review Board of the Tehran University of Medical Sciences. All aspects of the study were conducted according to the Declaration of Helsinki. All participants gave informed consent for participation in the study.

Variable measurement

The study measured both subjective variables (i.e. comorbidity, smoking, aspirin sensitivity and nasal polyposis symptoms) and objective variables (i.e. results for nasal endoscopy, radiography and histopathological tissue analysis).

We evaluated any previous history of diabetes, cystic fibrosis, cigarette smoking or aspirin sensitivity (of any type), in addition to other demographic data. We also recorded the duration of symptoms. The Sino-Nasal Outcomes Test 22 was used to calculate a subjective sinusitis symptom score, both pre-operatively and 24 months post-operatively, under the supervision of one of the authors.

Pre-operatively, all patients underwent a complete nasal examination, including nasal endoscopy, to determine the presence of polyps, septal deviation and other anatomical variations. Stammberger's classification was used to grade the extent of the polyposis (I = polyps limited to middle meatus, II = polyps partially occupying the nasal space but not reaching the inferior meatus, and III = polyps reaching the inferior meatus).[4]

All patients underwent complete nasal and sinus tomography. The images were scored according to the Lund–Mackay system, prior to surgery. All images were assessed and reported by the same radiologist.

Surgically removed tissue specimens were all examined by the same pathologist, noting especially the presence of eosinophilic infiltration.

Treatment

In order to reduce inflammation and mucosal swelling and to facilitate surgery, oral prednisolone was prescribed to all patients for the three days before surgery.

All operations were performed by one of the authors using the same method, under general anaesthesia. Messerklinger's method of endoscopic surgery was used. The same pre- and post-operative protocol was used for each patient, including endoscopic debridement under the supervision of one of the senior authors. The surgeon attempted to completely open all involved sinus cells, especially in the base of the skull, as well as to preserve the mucosa of unaffected areas. Additionally, the middle turbinate was partially resected if there were extensive polypoid changes. Septoplasty was performed when indicated. Anterior and posterior ethmoidectomy and maxillary antrostomy were performed in all cases. Frontal and sphenoid sinusotomy were performed if indicated.

Post-operatively, all patients were treated with broad-spectrum antibiotics for two weeks. In addition, all patients continued treatment with the same medical regimen for nasal polyposis (i.e. inhaled nasal corticosteroid (fluticasone propionate) twice daily (with dosage adjustment depending on endoscopic findings) plus nasal saline douches thrice daily) for at least six months. All patients also received a short course of oral corticosteroids (prednisolone 20 mg for an average adult) for one week post-operatively.

Subsequently, all patients underwent endoscopic follow up, and any recurrence was documented. Patients with recurrence were given maximal medical treatment; if this failed, revision surgery was performed.

Statistical analysis

Various factors which may have affected disease recurrence were statistically compared, including disease extent, age, sex, smoking and disease histopathology.

Data were analysed via one-way analysis of variance, Mann–Whitney test, Spearman's correlation test, chi-square test and *t*-test, using the Statistical Package for the Social Sciences version 16 software program. A p value of less than 0.05 was considered significant. Data are presented as mean ± standard deviation.

TABLE I
PATIENT CLINICAL CHARACTERISTICS

Characteristic	Pts (*n* (%))
Asthma	20 (20)
Sampter's triad	10 (10)
Cystic fibrosis	4 (4)
Smoking	21 (21)
Revision surgery	27 (27)

TABLE II
PATIENTS' PRE- AND POST-OPERATIVE SNOT22 SYMPTOM SCORES

Time point	Score (mean ± SD)
Pre-operative	19.7 ± 4.5
Post-operative	5.17 ± 2.75

SNOT22 = Sino-Nasal Outcome Test 22; SD = standard deviation

TABLE III
POST-OPERATIVE NASAL POLYPOSIS RECURRENCE

Time after surgery (mth)	Pts with rec (*n* (%))
6	19 (19)
12	39 (39)
24	43 (43)

Mth = months; Pts = patients; rec = recurrence

Results

One hundred patients were enrolled in the study. Of these, 20 per cent had a history of asthma and 27 per cent had undergone previous surgery. Fifty-eight (58 per cent) of the patients were male and 42 (42 per cent) female. The mean patient age was 37.7 ± 12.6 years (range, 16–68 years). The mean duration of disease before surgery was 4.1 ± 2.8 years. Patients' characteristics are summarised in Table I.

Using Stammberger's endoscopic classification system, 82 per cent of patients were stage II and the rest were stage III.

The mean pre-operative Lund–MacKay score was 20 ± 6.

The pre- and post-operative Sino-Nasal Outcome Test 22 scores are presented in Table II. Post-operative scores were significantly lower than pre-operative scores ($p < 0.001$; *t*-test). Of the different test items, a significant difference was noted for smell condition, comparing pre- and post-operative results ($p < 0.001$; chi-square).

After two years of endoscopic follow up, 43 per cent of patients had polyp recurrence but only 8 per cent of these patients required surgery. Table III presents post-operative recurrence data.

Statistical associations between various parameters were analysed.

TABLE IV
EFFECT OF CLINICAL VARIABLES ON SNOT22 AND LUND–MACKAY SCORES

Tool	Clinical status	Score (mean ± SD)	*p*
SNOT22, pre-op	Asthma	48.2 ± 11.2	0.23
	No asthma	42.2 ± 13.2	
SNOT22, post-op	Asthma	13.2 ± 4.7	0.45
	No asthma	10.5 ± 5.2	
Lund–Mackay	Asthma	20.7 ± 3.2	0.78
	No asthma	19.9 ± 3.7	
SNOT22, pre-op	Sampter's triad	59.5 ± 13.7	0.034*
	No Sampter's triad	43.2 ± 10.7	
SNOT22, post-op	Sampter's triad	20.5 ± 8.2	0.021*
	No Sampter's triad	12 ± 4.7	
Lund–Mackay	Sampter's triad	22.3 ± 3.2	0.35
	No Sampter's triad	20.3 ± 1.3	
SNOT22, pre-op	Cystic fibrosis	49 ± 15.5	0.62
	No cystic fibrosis	44.5 ± 12.2	
SNOT22, post-op	Cystic fibrosis	15.2 ± 7.7	0.40
	No cystic fibrosis	10.2 ± 4.2	
Lund–Mackay	Cystic fibrosis	20.3 ± 5.8	0.87
	No cystic fibrosis	20.1 ± 5.5	
SNOT22, pre-op	Smoking	46.5 ± 11.2	0.75
	No smoking	49.7 ± 15.5	
SNOT22, post-op	Smoking	15.2 ± 8.2	0.66
	No smoking	13 ± 4.2	
Lund–Mackay	Smoking	22.1 ± 2.4	0.14
	No smoking	19.7 ± 3.5	
SNOT22, pre-op	Eosinophilia	50.5 ± 13.7	0.62
	No eosinophilia	45.2 ± 10.7	
SNOT22, post-op	Eosinophilia	12.2 ± 6.7	0.74
	No eosinophilia	13 ± 4.7	
Lund–Mackay	Eosinophilia	21.3 ± 2.5	0.46
	No eosinophilia	19.6 ± 3.1	
SNOT22, pre-op	Diabetes	42.5 ± 16.2	0.69
	No diabetes	45.5 ± 13.2	
SNOT22, post-op	Diabetes	6.7 ± 6	0.11
	No diabetes	11.7 ± 6.2	
Lund–Mackay	Diabetes	20.8 ± 2.6	0.76
	No diabetes	20.1 ± 2.9	

*Significant (Mann–Whitney). SNOT22 = Sino-Nasal Outcome Test 22; SD = standard deviation; pre-op = pre-operative; post-op = post-operative

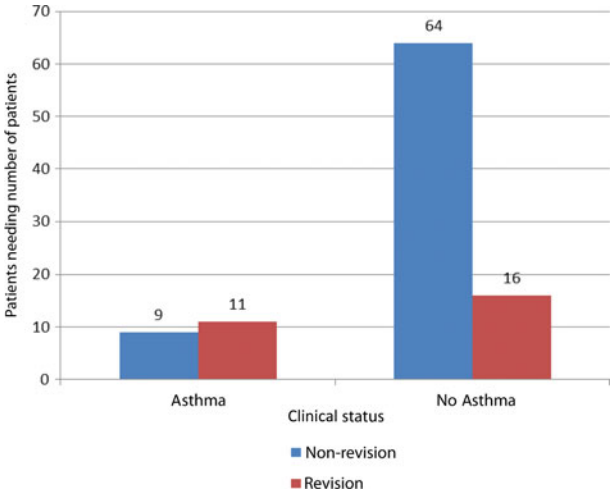

FIG. 1
Histogram showing relationship between asthma history and revision surgery prevalence.

There was no significant difference in post-operative Sino-Nasal Outcome Test 22 score improvement, comparing male and female patients ($p = 0.53$).

There was no significant association between age and Sino-Nasal Outcome Test 22 score, either before surgery (Pearson correlation = 0.12; $p = 0.209$) or after surgery (Pearson correlation = 0.099; $p = 0.83$).

The effects of asthma, Sampter's triad, cystic fibrosis, smoking, eosinophilic infiltration and diabetes on pre- and post-operative Sino-Nasal Outcome Test 22 and Lund–Mackay scores are summarised in Table IV.

The relationship between the nasal endoscopy staging score and various other factors was evaluated using logistic regression. Nasal endoscopy staging correlated only with the Sino-Nasal Outcome Test 22 score.

The presence or absence of eosinophilia had no significant relationship with the presence of asthma or Sampter's triad.

There was a significant relationship between a clinical history of asthma and the requirement for revision surgery ($p = 0.032$; chi-square). These results are summarised in Figure 1.

TABLE V
EFFECT OF REVISION STATUS ON SNOT22 AND LUND–MACKAY SCORES

Tool	Revision status	Score (mean ± SD)	p
SNOT22, pre-op	Revision	52.7 ± 14.7	0.038*
	No revision	42 ± 9.7	
SNOT22, post-op	Revision	12 ± 5.7	0.53
	No revision	13.7 ± 6.5	
Lund–Mackay	Revision	20.9 ± 6.7	0.95
	No revision	20.1 ± 6.2	

*Significant (Mann–Whitney). SNOT22 = Sino-Nasal Outcome Test 22; SD = standard deviation; pre-op = pre-operative; post-op = post-operative

TABLE VI
EFFECT OF CLINICAL VARIABLES ON NASAL POLYPOSIS RECURRENCE

Clinical condition	Present?	Rec (pts; n (%))	p*
Asthma	Yes	17 (85)	<0.001†
	No	26 (32.5)	
Sampter's triad	Yes	3 (60)	0.43
	No	40 (42.1)	
Cystic fibrosis	Yes	2 (50)	0.66
	No	41 (43.8)	
Smoking	Yes	10 (47.6)	0.63
	No	33 (42)	
Eosinophilia	Yes	16 (64)	0.014†
	No	27 (36)	
Revision	Yes	15 (55.6)	0.072
	No	28 (38.4)	
Diabetes	Yes	2 (40)	0.89
	No	41 (43.2)	

*Chi-square test. †Significant. Rec = recurrence; pts = patients

Pre- and post-operative Sino-Nasal Outcome Test 22 and Lund–Mackay scores in revision and non-revision cases are compared in Table V.

Finally, the associations between various possible aetiological factors and recurrence are shown in Table VI.

In the short term, there was a significant difference in post-operative surgical outcomes, comparing revision versus non-revision cases; however, there was no significant difference after two years' follow up (Table VII).

In summary, after two years' follow up, no signs of recurrence were detected in 57 (57 per cent) of the 100 patients. The remainder of patients showed evidence of recurrence: 35 (35 per cent) had stage I recurrence (i.e. only in the middle meatus) and eight (8 per cent) had stage II recurrence.

As regards complications, one of our patients developed peri-operative cerebrospinal fluid leakage from the fovea ethmoidalis, which was repaired using a middle turbinate flap, with no further complications. Two other patients experienced epistaxis requiring extra packing.

Discussion

Nasal polyposis is a common sinus problem and is considered difficult to treat. Although endoscopic sinus surgery is now accepted as the standard treatment, the best method of surgery and the most important prognostic factors are still controversial.[9] Of the various possible causes of failure, untreated sinus cells are a common finding in revision cases.[13] Thus, we decided to evaluate the effect of meticulous sinus surgical technique, with careful attention paid to all involved sinus cells, on the outcome of massive nasal polyposis surgery. Accordingly, we assessed the effect of various factors which may influence recurrence.

Our study patients showed a variety of risk factors, including asthma, aspirin sensitivity, cystic fibrosis and smoking, history of previous surgery as well as high Lund–Mackay scores. Considering this, a recurrence rate of eight per cent after two years is remarkably

TABLE VII
NASAL POLYPOSIS RECURRENCE IN REVISION AND NON-REVISION CASES

Case type	Rec at 6 mth		Rec at 1 yr		Rec at 2 yr	
	Pts (*n* (%))	*p*	Pts (*n* (%))	*p*	Pts (*n* (%))	*p*
Revision	9 (30)	0.012*	13 (48)	0.041*	15 (55)	0.072
Non-revision	10 (12)		26 (30)		28 (38)	

*Significant. Rec = recurrence; mth = months; yr = years; Pts = patients

low. Thus, we believe that meticulous endoscopic sinus surgical technique can reduce the recurrence of nasal polyposis in patients with chronic rhinosinusitis.

In a similar study, Rhoda and Gady found a 60 per cent recurrence rate after surgery, and concluded that severe nasal polyposis had a significant incidence of post-operative recurrence.[1]

Like other authors, we partially resected the middle turbinates, and this may have affected the recurrence rate.[16]

In addition, we meticulously opened all involved sinus cells in order to eliminate sinus pathology; we also preserved uninvolved mucosa. We believe that this approach improved the response to surgical treatment.

Cystic fibrosis has been proposed as a risk factor for post-surgical recurrence of nasal polyposis.[6] Four per cent of our patients had cystic fibrosis. In our series, the small number of patients with this condition may have influenced the statistical significance of its effect on recurrence.

Although many reports have found that cigarette smoking, diabetes and aspirin sensitivity have an effect on post-operative nasal polyposis recurrence, a significant effect was not seen in our series. On the other hand, we did observe a significant relationship between eosinophilia and nasal polyposis recurrence, confirming other authors' data.[12,17] Moreover, asthma and eosinophilia both had similar effects on recurrence, which was in line with other reports.[1]

- **Meticulous endoscopic opening of all involved sinus cells can safely control massive nasal polyposis**
- **Recurrence rates are acceptable**
- **Recurrence is significantly associated with eosinophilia and previous asthma**

The presence of Sampter's triad had a significant effect on patients' symptoms in both the pre-operative and post-operative periods. Despite having a higher recurrence rate and worse surgical outcomes, patients with Sampter's triad did benefit from surgery (at least during the study period).

We noted that patients who required revision surgery had a worse prognosis; this finding was in keeping with similar reports.[9,18] Dursun *et al.* noted similar findings in a retrospective study, and recommended medical treatment before surgery.[9]

In a similar study, Masterson *et al.* found a lower recurrence rate in patients receiving extensive sinus surgery.[14,19] These authors suggested that their findings should be evaluated in further research, because of the limitations of their study. Future such studies may provide the basis for better understanding of nasal polyposis pathophysiology and treatment modalities.

Finally, the limitation of this study was that patients were only followed up for two years; thus, predictions about the long-term outcome of nasal polyposis surgery cannot be made. Therefore, future studies should be designed with larger patient series and longer follow-up periods, in order to investigate the effect of meticulous endoscopic sinus surgery on nasal polyposis outcome.

Conclusion

Current study can present meticulous endoscopic sinus surgery opening of all involved cells as an effective way of controlling of massive nasal polyposis.

References

1 Wynn R, Har-El G. Recurrence rates after endoscopic sinus surgery for massive sinus polyposis. *Laryngoscope* 2004; **114**(5):811–3
2 Poetker D, Mendolia-Loffredo S, Smith L. Outcomes of endoscopic sinus surgery for chronic rhinosinusitis associated with sinonasal polyposis. *Am J Rhinol* 2007;**21**:84–8
3 Smith T, Loffredo S, Loehrl T, Sparapani R, Laud W, Nattinger A. Predictive factors and outcomes in endoscopic sinus surgery for chronic rhinosinusitis. *Laryngoscope* 2005;**115**:2199–205
4 Dufour X, Bedier A, Ferrie J, Gohler C, Klossek J. Diffuse nasal polyposis and endonasal endoscopic surgery: long-term results, a 65-case study. *Laryngoscope* 2004;**114**:1982–7
5 Bonfils P, Avan P. Evaluation of the surgical treatment of nasal polyposis. II: influence of a non-specific bronchial hyperresponsiveness. *Acta Otolaryngol* 2007;**127**:847–54
6 Tilman K, Ajnacs R. Medium-term symptom outcomes after paranasal sinus surgery in children and young adults with cystic fibrosis. *Laryngoscope* 2007;**117**:475–9
7 Lavigne F, Nguyen C, Cameron L, Hamid Q, Ren M. Prognosis and prediction of response to surgery in allergic patients with chronic sinusitis. *Allergy Clin Immunol* 2000;**105**:746–51
8 Watelet JB, Annicq B, Van Cauwenberge P, Bachert C. Objective outcome after functional endoscopic sinus surgery: prediction factors. *Laryngoscope* 2004;**114**:1092–7
9 Dursun E, Korkmaz H, Eryilmaz A, Bayiz U, Sertkaya D, Sami E. Clinical predictors of long-term success after endoscopic sinus surgery. *Otolaryngol Head Neck Surg* 2003;**129**:626–31
10 Lee J, Lee S. Influence of age on the surgical outcome after endoscopic sinus surgery for chronic rhinosinusitis with nasal polyposis. *Laryngoscope* 2007;**117**:1084–9

11 Cohen N, Kennedy D. Revision endoscopic sinus surgery. *Otolaryngol Clin North Am* 2009;**39**:188–92
12 Tosun F, Arslan H, Karslioglu Y, Deveci M, Durniaz A. Relationship between postoperative recurrence rate and eosinophil density of nasal polyps. *Ann Otolaryngol* 2010;**119**:455–9
13 Musy Y, Kountakis E. Anatomic findings in patients undergoing revision endoscopic sinus surgery. *Am J Otolaryngol* 2004;**25**: 418–22
14 Masterson L, Tanweer F, Bueser T, Leong P. Extensive endoscopic sinus surgery: does this reduce the revision rate for nasal polyposis? *Eur Arch Otorhinolaryngol* 2010;**18**:233–7
15 Telmesani L, Al-Shawarby M. Osteitis in chronic rhinosinusitis with nasal polyps: a comparative study between primary and recurrent cases. *Eur Arch Otorhinolaryngol* 2010;**267**:721–4
16 Marchioni D, Ciufelli M, Mattioli F, Marchetti A, Jovic G, Massone F *et al*. Middle turbinate preservation versus middle turbinate resection in endoscopic surgical treatment of nasal polyposis. *Acta Otolaryngol* 2008;**128**:1019–26
17 Gerstner A, Gutschew M, Cheler M, Machlittw J, Emmrichz F, Sommerer F *et al*. Eosinophilia in nasal polyposis: its objective quantification and clinical relevance. *Clin Exp Allergy* 2004;**34**: 65–70
18 McMains K, Kountakis S. Revision functional endoscopic sinus surgery: objective and subjective surgical outcomes. *Am J Rhinol* 2005;**19**:344–7
19 Hopkins C, Browne JP, Slack R, Lund V, Topham J, Reeves B *et al*. The national comparative audit of surgery for nasal polyposis and chronic rhinosinusitis. *Clin Otolaryngol* 2006;**31**:390–8

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