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Headache Characteristics in Rhinologic Patients and the Role of Surgical Treatment

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ABSTRACT

Objectives : Even though headache is a common symptom in patients with chronic rhinosinusitis (CRS) or nasal septal deviation (NSD), there are very few recent reports investigating headache characteristics in rhinologic patients. Therefore, we investigated the headache characteristics and differences in CRS and NSD patients who were diagnosed by computerized tomography and endoscopic exams. **Methods** : We enrolled 257 patients who had undergone nasal and sinus surgery between January 2012 and December 2013. The subjects were divided into a CRS group (n=147) and NSD group (n=110). They were asked to fill out a Sinonasal Outcome Test (SNOT-20) and questionnaire about pre-operation headaches (1 day prior) and post-operation headaches (1 month after) they experienced, to evaluate their sinonasal symptoms and headache characteristics. **Results** : There was no significant pre-operative difference in rhinologic symptoms and headache characteristics between the CRS and NSD groups. Females experienced more headaches. Both groups reported significant improvements to their headaches after surgery; however, we found no significant differences in the degree of improvement between the two groups. **Conclusions** : There was no significant difference in the headache characteristics and the degree of post-operative improvement between the CRS and NSD groups. Surgical treatments appear to reduce headaches in patients with rhinologic diseases.

KEY WORDS : Headache · Chronic rhinosinusitis · Septal deviation · Sinus headache · Endoscopic sinus surgery · Septoplasty.

INTRODUCTION

Sinonasal diseases are well known for causing referred headaches and facial pain over the area of the affected sinus, and may be associated with relevant nasal and sinus symptoms, such as nasal obstruction, purulent rhinorrhea, posterior nasal drip, foul smell, and hyposmia.[1] One of the most common prevalent secondary headaches is probably headache attributed to rhinosinusitis.[2] Septal deviations with septal spurs or ridges also induce headaches, which are called septal contact headaches or rhinopathic headaches.[3] Although headaches can result from sinusitis, neurogenic causes, or both, this knowledge is poorly disseminated among patients and physicians.[4-7] Rhinitis, rhinosinusitis, and migraines affect common locations, have overlapping symptoms (nasal congestion, rhinorrhea, facial pressure-pain-fullness, headache) and precipitating triggers (weather changes, inhaled irritants, allergies) creating diagnostic challenges. Therefore, migraines are commonly misdiagnosed as sinusitis (sinus headache), or sinonasal and migrainous disorders are also frequently comorbid.[8][9]

Otolaryngologists can mandate objective confirmation of sinonasal diseases by either nasal endoscopy or computed tomography for patients with headaches. Many rhinologists clinically experience the patients with rhinology diseases complaining of their headaches regardless of migraine existence. They are of the opinion that chronic irritation of the mucosa or direct contact between the septum and the mu-

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cosa of the turbinates are the main causes of nasal headache.[10-12] They pointed out that small ostia leading to the paranasal sinuses may easily be closed and bring about defective sinus ventilation, contributing to the patient's complaints.[12][13]

Even though headache is a common symptom in rhinologic patients with chronic rhinosinusitis (CRS) or nasal septal deviation (NSD), there are very few recent reports investigating headache characteristics in rhinologic patients. In addition, no studies have yet compared headache characteristics between CRS and NSD patients. Therefore, we investigated headache characteristics and differences in CRS and NSD patients who were diagnosed by computerized tomography (CT) and endoscopic exam. Additionally, we evaluated the effects of surgery on headaches in CRS and NSD patients.

SUBJECTS AND METHODS

Subjects

We examined 367 adults aged 18 and over who had been hospitalized for surgical treatment of NSD or CRS at our Hospital between January 2012 and December 2013. The CRS group, regardless of nasal polyps, had undergone endoscopic sinus surgery for CRS. CRS patients were listed for surgery on the basis of having chronic sinonasal symptoms resistant to medical therapy for more than 12weeks and having demonstrable pathology radiologically and on clinical examination. The NSD group had undergone septoplasty for a deviated nasal septum. NSD patients supposed to encompass nasal obstruction patients with nasal septal deviation and without signs of sinusitis on endoscopic exam or CT. Of these subjects, those with a facial trauma or other surgical or internal medical diseases or psychological records were excluded. We ended up enrolling 257 adults who then filled out a questionnaire 1 month post-operation. The subjects were grouped into a CRS group (n=147) and NSD group (n=110).

Study design

The study was approved by the hospital's institutional review board (2012-027). The subjects were assessed using the Sinonasal Outcome Test (SNOT-20) and a questionnaire 1 day pre-operation and 1 month post-operation for rhinological disease-caused symptoms and headache characteristics (location, time of occurrence, accompanied symptoms, etc.) and severity (intensity, frequency, duration, etc.). One doctor performed Lund-Mackay scoring by using a pre-operative ostiomeatal unit (OMU) CT to analyze the correlation between the Lund -Mackay CT score and pre-operative headache characteristics.

Questionnaire

SNOT-20 is a questionnaire that modifies Rhinosinusitis Outcome Measure-31 to identify symptoms caused by rhinologic diseases.[14] Patients choose from 6 levels for 20 questions. Each level is scored between 0 and 5 to calculate a total score for the whole 20 questions, as well as scores for specific areas, such as rhinological symptoms, and ear/facial, sleep, and psychological symptoms. The questionnaire on headache has 8 questions on intensity, frequency, duration, occurrence time of day, character, direction, accompanying symptoms, and limitations to daily life. A higher score indicates greater intensity and longer duration; a lower score indicates greater frequency.

Data analysis

In this study, we first compared the headache characteristics of the NSD and CRS groups. We also looked into correlations between the pre-operative survey questions for the two groups. We studied post-operative changes in headache characteristics for the two groups.

Statistical analysis

Statistical analysis was performed using SPSS 19.0 for Windows (SPSS, Inc., an IBM Company, Chicago, IL, USA). We used the χ^2 test with a 5% level of significance for comparison of proportions between the NSD and CRS groups. Fisher's exact test was used when appropriate. The t-test or Mann-Whitney U-test was used for continuous variables for the NSD and CRS groups. Additionally, we conducted a multivariable regression analysis to determine the best set of independent predictors for headache in NSD and CRS subjects. We used Spearman's correlation coefficient for correlation between headache and CT score in the CRS subjects, and between headache and SNOT scores in the NSD and CRS subjects. To compare post-operative outcomes, a paired t-test or Wilcoxon signed rank test was used. Statistical significance was set at a p-value less than 0.05.

RESULTS

Demographic data

The demographic data are summarized in Table 1. The average age of the CRS group was 46.7 years; and that of the NSD group, 32.4 years. The CRS group showed a significantly higher average age ($p < 0.001$). As for sex, the CRS group had significantly more females than the NSD group

(p=0.001). No significant difference was found in the pre-operative SNOT average scores between the two groups (p=0.884). The CRS group had significantly more pre-operative headache cases (p=0.037); however, in multivariable analysis headache was not associated with age in either group. Headache was found to be associated with the female sex (p=0.001, odd ratio=2.658)(Table 2).

Comparison of headache characteristics between the CRS and NSD groups

Fifty-seven patients of 147 CRS patients (38.8%) presented preoperative headaches, and 29 patients of 110 NSD patients (26.4%) showed headaches preoperatively. We made a comparison of headache characteristics in patients with headache according to sinonasal diseases. There was no significant difference in headache characteristics between the CRS and NSD groups (Table 3). The mean headache intensity was moderate for both groups (CRS=4, NSD=5). For headache frequency, both of the groups most commonly experienced headache 1−3 times a week (CRS=42.3%, NSD=42.3%). Headache duration for both groups was less than 3 hours (CRS=50.9%, NSD=48.3%). The time of day that the headache occurred was typically in the afternoon for both groups (CRS=40.4%, NSD=31%). As for headache patterns, pulsating was the most common (CRS

Table 1. Subject characteristics according to nasal disease

	CRS (n=147)	NSD (n=110)	p-value
Age (years) (Mean value)	46.77	32.41	<0.001*
Sex			
Female	38.1%	19.1%	0.001*
Male	61.9%	80.9%	
Pre-op SNOT-20 (Mean value, 0−100)	27.24	27.50	0.884
Pre-op headache			
No	61.2%	73.6%	0.037*
Yes	38.8%	26.4%	

*: p-value<0.05. Pre-op SNOT-20: pre-operative Sinonasal Outcome Test-20 total score, CRS: chronic rhinosinusitis, NSD: nasal septal deviation

Table 2. Multivariable analysis of pre-operative headaches

	Odds ratio	95% confidence interval	p-value
Nasal disease			
NSD	1		
CRS	1.819	0.972−3.406	0.061
Sex			
Male	1		
Female	2.658	1.475 – 4.792	0.001*
Age (years)			
<30	1.831	0.845−3.968	0.125
30−50	1.190	0.585−2.422	0.631
≥50	1		0.285
Pre-op SNOT-20	1.028	1.008−1.049	0.006*

*: p-value<0.05. Pre-op SNOT-20: pre-operative Sinonasal Outcome Test-20 total score, CRS: chronic rhinosinusitis, NSD: nasal septal deviation

Table 3. Comparison of headache characteristics between CRS group and NSD group

Variables	CRS (n=57)	NSD (n=29)	p-value
Intensity (VAS, 0−10)	4	5	0.677
Frequency of attacks			0.476
Daily	11 (21.2%)	3 (11.5%)	
1–3/week	22 (42.3%)	11 (42.3%)	
1-3/month	16 (30.8%)	8 (30.8%)	
< 1/month	3 (5.8%)	4 (15.4%)	
Duration of attacks (hours)	29 (50.9%)	14 (48.3%)	0.182
< 3	11 (19.3%)	4 (13.8%)	
3−4	8 (14.0%)	7 (24.1%)	
4−24	0	2 (6.9%)	
24−72	4 (7.0%)	2 (6.9%)	
72−168	5 (8.8%)	0	
Time of attacks			
Wake up	8 (14.0%)	5 (17.2%)	
Morning	8 (14.0%)	4 (13.8%)	
Afternoon	23 (40.4%)	9 (31.0%)	
Evening	10 (17.5%)	4 (13.8%)	
Bedtime	1 (1.8%)	1 (3.4%)	
All day	6 (10.5%)	6 (20.7%)	
Unknown	1 (1.8%)	0	
Characters of attacks			0.851
Pulsating	22 (38.6%)	14 (48.3%)	
Pressing/tightening	16 (28.1%)	6 (20.7%)	
Fulgurating	8 (14.0%)	4 (13.8%)	
Other	11 (19.3%)	5 (17.2%)	
Direction of attacks			0.864
Right	9 (19.1%)	5 (22.7%)	
Left	8 (17.0%)	2 (9.1%)	
Both	18 (38.3%)	10 (45.5%)	
Alternating	12 (25.5%)	5 (22.7%)	
Accompanying symptoms			
Loud sound	4 (6.6%)	1 (2.9%)	
Flashing light	0	1 (2.9%)	
Nausea/vomiting	9 (14.8%)	5 (14.7%)	
Diarrhea	0	1 (2.9%)	
Nasal obstruction	19 (31.1%)	10 (29.4%)	
Rhinorrhea	9 (14.8%)	3 (8.8%)	
None	19 (31.1%)	13 (38.2%)	
Limitations to daily life			
Work or studies	11 (19.3%)	12 (40.0%)	
Housekeeping activity	6 (10.5%)	2 (6.7%)	
Leisure activity	3 (5.3%)	1 (3.3%)	
All activity	18 (31.6%)	7 (23.3%)	
None	18 (31.6%)	8 (26.7%)	

CRS: chronic rhinosinusitis, NSD: nasal septal deviation, VAS: visual analogue scale

=38.6%, NSD=48.3%), and headaches occurred most frequently on both sides of the head (CRS=38.3%, NSD=45.5%). The subjects did not report experiencing any typical accompanying symptoms (CRS=31.1%, NSD=38.2%) or nasal obstructions (CRS=31.1%, NSD=29.4%). Many of the respondents said their headache disturbed their study or work (CRS=19.3%, NSD=40%) or every activity (CRS=31.6%, NSD=23.3%).

We investigated the relationship between headache locations and sinonasal lesions in patients with headaches (Table 4). CRS patients with both lesions mainly showed their headache in bilateral or alternative directions, but 13 of bilateral CRS patients presented unilateral headaches. Unilateral CRS patients had not only ipsilateral headaches but also bilateral headaches. NSD patients also had mostly bilateral or alternative headaches regardless of direction of septal deviations. Especially, we checked 11 cases of CT scans in NSD groups. There were 9 septal spurs and 3 concha bullosa. Of these scans, 4 cases made a contact points and only one of them corresponded the direction of nasal lesions with the direction of headaches.

Table 4. Relationship between headache locations and sinonasal lesions in patients with headaches

Direction of headache	Right	Left	Both	Alternative
Direction of CRS (n=57)				
Right	2	0	2	0
Left	1	1	2	0
Both	6	7	14	12
Direction of NSD (n=29)				
Right	4	0	8	0
Left	1	2	2	5

∗: Ten patients of CRS and 2 patients of NSD didn't check their headache locations. CRS: chronic rhinosinusitis, NSD: nasal septal deviation

Table 5. Correlation coefficients between pre-operative headache characteristics and pre-operative SNOT-20 in the chronic rhinosinusitis group (n=57)

Pre-op SNOT-20	Pre-operative headache characteristics		
	Intensity	Frequency	Duration
Total score			
Correlation coefficient	0.198	−0.111	0.130
p-value	0.016*	0.189	0.115
Rhinologic			
Correlation coefficient	0.029	0.013	−0.013
p-value	0.724	0.878	0.877
Ear/facial			
Correlation coefficient	0.305	−0.248	0.239
p-value	<0.001*	0.003*	0.004*
Sleep			
Correlation coefficient	0.148	−0.065	0.086
p-value	0.074	0.441	0.298
Psychological			
Correlation coefficient	0.167	−0.204	0.190
p-value	0.043*	0.015*	0.021*

∗: p-value<0.05. Pre-op SNOT-20: pre-operative Sinonasal Outcome Test-20 total score

Comparison of pre-operative SNOT scores and headache characteristics of the two groups

We made a comparison of preoperative SNOT scores in patients with headache according to sinonasal diseases. In the CRS group, pre-operative SNOT score and headache characteristics were compared and a significant correlation was found between SNOT total score and headache intensity (p=0.016). A stronger correlation was found between ear/facial symptoms and intensity, frequency, and duration of headache ($p < 0.001$, p=0.003, p=0.004) (Table 5).

In the NSD group, pre-operative SNOT score and headache characteristics were compared and a significant correlation was also found between SNOT total score and the headache features of ear/facial symptoms, and sleep symptoms (Table 6).

Correlation between pre-operative headache characteristics and Lund Mackay CT score in the CRS group

The objective status of the CRS group using the Lund

Table 6. Correlation Coefficient between pre-operative headache characteristics and pre-operative SNOT-20 in the nasal septal deviation group (n=29)

Pre-op SNOT-20	Pre-operative headache characteristics		
	Intensity	Frequency	Duration
Total score			
Correlation coefficient	0.392	−0.375	0.374
p-value	<0.001*	<0.001*	<0.001*
Rhinologic			
Correlation coefficient	0.139	−0.113	0.148
p-value	0.147	0.247	0.123
Ear/facial			
Correlation coefficient	0.387	−0.347	0.348
p-value	<0.001*	<0.001*	<0.001*
Sleep			
Correlation coefficient	0.283	−0.303	0.298
p-value	0.003*	0.001*	0.002*
Psychological			
Correlation coefficient	0.328	−0.285	0.264
p-value	<0.001*	0.003*	0.006*

∗: p-value<0.05. Pre-op SNOT-20: pre-operative Sinonasal Outcome Test-20 total score

Mackay CT score was not associated with intensity, frequency, or duration of headache (p=0.903, p=0.899, p=0.423) (Table 7).

Comparison of headache characteristics between pre-operative and 1-month post-operative mean score

Approximately 80% of the subjects in the CRS and NSD groups had an improved status 1-month post-operation versus pre-operation, with no significant difference between the groups (Table 8). When compared with average scores, both groups showed significant improvement ($p < 0.001$), with no significant difference between the groups (Table 9).

DISCUSSION

In this study, we figured out the characteristics of headaches in CRS and NSD patients. We found that headaches tend to occur in the afternoon hours, in a pulsating pattern, are accompanied by nasal symptoms, occur on both sides of the head, and affect a patient's daily life. Endoscopic sinus surgery and septoplasty helped relieve many subjects with nasal diseases. We found no significant difference in not only the headache characteristics, but also the degree of post-operative improvement, between the CRS and NSD subjects. Interestingly, there was no difference of preoperative SNOT scores, in other words, other sinonasal symptoms between the CRS and NSD groups. Both groups may be showed the similar improvement of sinonasal symptoms as well as headaches after surgeries.

In a previous study, Nei Bhattacharyya et al.[15] also showed that severity of headache was not significantly different between CRS and NSD patients. They studied nasal symptoms and disease severity using the Sinonasal Outcome Test (SNOT-20), and differences in individual symptom scores, facial pressure, facial congestion, and headache were not statistically significant between CRS and NSD subjects. Sometimes the presence of these symptoms is used to distinguish patients with potential diagnoses of CRS from NSD; but our outcomes also show that making these distinctions may be difficult if this clinical distinction is based on symptoms alone. It is possible that subjects with NSD reported headache similar to subjects with CRS because of septal deviations with septal spurs or ridges.[1] This study showed that the direction of septal deviation was not related to the direction of headaches. Previous study also found that the pain was rarely felt at the affected sites, but rather referred to other areas of the head.[12] Headache in NSD groups may

Table 7. Correlation coefficient between pre-operative headache characteristics and Lund-Mackay CT score in the chronic rhinosinusitis group (n=57)

Pre-operative headache characteristics	Correlation coefficient	p-value
Intensity	−0.010	0.903
Frequency	0.011	0.899
Duration	−0.067	0.423

Table 8. Comparison between pre-operative and 1-month post-operative mean score of headache characteristics according to nasal disease (%)

Questionnaire	CRS (n=57)		NSD (n=29)		p-value*
	Worse or no change (%)	Better (%)	Worse or no change (%)	Better (%)	
Headache					
Intensity	15.8	84.2	13.8	86.2	1.000
Frequency	22.4	77.6	19.2	80.8	0.746
Duration	17.5	82.5	24.1	75.9	0.468

*: p-value: for difference between CRS & NSD groups. CRS: chronic rhinosinusitis, NSD: nasal septal deviation

Table 9. Comparison between pre-operative and 1-month post-operative mean score of headache characteristics according to nasal disease (mean value)

Questionnaire	CRS (n=57)			NSD (n=29)			p-value‡
	Pre-op	Post-op 1 month	p-value†	Pre-op	Post-op 1 month	p-value†	
Headache							
Intensity	4.53	1.07	<0.001*	4.24	1.24	<0.001*	0.499
Frequency	2.24	4.24	<0.001*	2.50	4.38	<0.001*	0.520
Duration	2.19	0.51	<0.001*	2.10	0.72	0.001*	0.530

A higher score indicates greater intensity and longer duration; a lower score indicates greater frequency. *: p-value < 0.05, †: p-value: for difference between pre-op & 1 month post-op, ‡: p-value: for difference in improvement between CRS & NSD groups. CRS: chronic rhinosinusitis, NSD: nasal septal deviation, Pre-op: pre-operative mean value, Post-op 1 month: 1-month post-operative mean value

be caused by not only direct contacts on the nasal mucosa but noxious indirect stimuli such as mechanical, chemicals, and hydrothermal variations.

We found a significantly correlated relationship in the CRS group between headache and total symptoms, and an even stronger correlation with ear/facial symptoms. In the NSD group, headache and total symptoms, ear/facial, sleep, and psychological symptoms were found to have significant correlation. The finding that both groups had correlation between rhinologic symptoms and headache may be because rhinologic disease is related to headache, as rhinologic symptoms normally arise from rhinologic diseases such as NSD and CRS, even though the causes of headache in the CRS and NSD subjects included migraine, tension headache, and other trigeminal autonomic cephalalgia, in addition to headache attributed to rhinosinusitis and contact point headache.

William H. Moretz et al.[16] described that when 201 subjects underwent surgical management of CRS, the mean subjective headache score, based on a 0-10 visual analog scale, improved 2 years post-operatively. HH Huang et al.[1] proposed that 30 subjects suffering from nasal septum abnormalities with headache had significantly improved headache intensity 1 month post-operative intervention for NSD or spurs. As in preceding studies, we compared pre-operative and 1-month post-operative mean scores for headache characteristics according to NSD and CRS group. Each subject, regardless of group, significantly improved in intensity, frequency, and duration of headache post-operation. Additionally, we found that there was no difference in the degree of improvement of headache between the groups. This was the first study to compare the post-operative effects on headache between CRS and NSD subjects. We demonstrated that ESS for CRS and septoplasty for NSD can have similarly effective results in resolving headaches in CRS and NSD patients.

In addressing rhinologic diseases, the correlation between objective status and patients' subjective symptoms is still unclear. Although this study looked at the CRS group for any correlation between Lund-Mackay CT score and characteristics of pre-operative headache, no statistically significant correlation was found with headache intensity, duration, or frequency. Basu et al.[17] reported that symptoms based on the Sinonasal Assessment Questionnaire in a CRS group had no correlation with the objective status based on Lund-Mackay CT score. Shields et al.[18] also found that facial pain or headache in CRS subjects and disease severity by sinus CT scan had no correlation. This is because CRS affects patients significantly, but a patient's suffering is subjective and may not be proportionate to severity. So it should be noted that the actual symptoms a patient reports during clinical treatment may be inconsistent with objective test results.

This study is important in that it first compared the characteristics of headaches suffered by CRS and NSD patients, and then looked at post-operative improvements in the two groups. In addition, there was another interesting finding that Koreans had less headache symptoms by CRS than Caucasians. According to previous reports, Caucasians CRS subjects experience fairly consistent headache rates ranging from 70% to 80%.[16][19][20] Our CRS subjects showed a much lower proportion of about 40%. Previous studies have supported lower headache prevalence in Asians than in Caucasians, and African and Asian American headaches differ from Caucasians on the reported occurrence of several headache features.[21][22] Several factors could explain the differences among racial groups, including study methods (case ascertainment, survey method, case definition), cultural factors related to differences in symptom reporting, environmental risk factors, or race-related genetic and metabolic factors.

Our study has some limitations. First, 1 month follow-up seemed to be short. However, other previous studies reported that postoperative symptoms of CRS patients did not change from 3 month after over 12 months.[20][23] We also found that both CRS and NSD patients showed unconverted postoperative nasal, emotional, and functional symptoms after 1 month, 3 months, and 6 months in previous study.[24] Nevertheless, it is important that future research investigate the long term outcomes of postoperative headache in CRS and NSD patients. Second, this research identified two groups of subjects diagnosed as CRS and NSD by endoscopic and CT exam, and we examined those with headache for characteristics of their headache. But the study did not investigate if the subjects had any previous treatment record or diagnosis regarding headache; we only recognized the headache of CRS and NSD patients. We cannot confirm that the cause of the headache is CRS or NSD. More significant study findings can be expected if International Headache Society criteria and other criteria are adopted to further specify headaches to compare headache features between CRS and NSD patients.

CONCLUSION

There is no significant difference in the headache characteristics and the degree of post-operative improvement between the CRS and NSD groups. Endoscopic sinus surgery

and septoplasty helped many subjects with nasal diseases get relief from headaches, and surgical treatments can be expected to improve the conditions of patients with rhinologic diseases that accompany headaches.

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