Rhinology, 45, 14-19, 2007

Endoscopic sinus surgery for 'sinus headache'*

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SUMMARY

The relationship between sinus disease and headache is complicated. We undertook a prospective study to examine the success of endoscopic sinus surgery for the alleviation of headache in a defined group of individuals. In particular we wished to discover whether the presence of asthma, nasal polyposis and purulent rhinosinusitis indicated that surgical intervention achieved any greater relief of symptoms compared to those without these conditions. Overall we found a significant improvement in headache symptoms after endoscopic sinus surgery, but subgroup analysis of patients with or without asthma, nasal polyposis and purulent rhinosinusitis showed no differences between the groups.

Key words: endoscopic sinus surgery, headache, asthma, nasal polyposis, outcome study

INTRODUCTION

The relationship between sinus disease and headache is complicated. The diagnosis of 'sinus headache' is contentious. With this in mind, the role of endoscopic sinus surgery for this symptom is poorly understood. The notion of 'sinus headache' indeed being a result of sinus pathology would be held as true if patients benefited from an intervention that was primarily directed at the sinuses. Scoring headache alongside other sinonasal symptoms such as facial pain was performed to clarify this symptom as a distinct entity yet quantifying this symptom in a comparable manner. Currently the decision to perform endoscopic sinus surgery is based on a combination of patient symptoms, clinical findings and radiological findings. We used the Sino Nasal Outcome Test (SNOT-22) with an added question requesting the patient to score their symptom of headache before and after endoscopic sinus surgery. We wished to demonstrate firstly whether there was any improvement in the symptom of headache, secondly to quantify this subjective improvement, thirdly to see how long lasting any improvement was and fourthly to determine whether factors such as asthma, nasal polyposis or a finding of intra-operative pus affected surgical outcome. These factors are of particular interest as they are often implicated in the aetiology of sinus disease and should therefore predict a favourable outcome in headache patients where headache is sinogenic in origin. Headache as a symptom must be separated from the symptom of facial pain to accordingly define it as a specific entity and avoid confusion on analysing results.

MATERIALS AND METHODS

Patients

We performed a non-randomized prospective study of patients undergoing endoscopic sinus surgery over a 2-year period at Ipswich Hospital. Patients were listed for surgery on the basis of having chronic sinonasal symptoms resistant to medical therapy and having demonstrable pathology radiologically and on clinical examination, this decision was not based solely on the patient's symptom of headache. Patients attending the ENT department at Ipswich Hospital all undergo a standard regime of medical treatment that includes the use of intranasal and oral steroids, allergy management, oral antibiotics and nasal douching for a minimum of 3 months. The extent of endoscopic surgery performed was as appropriate to clear all disease demonstrated at the specific anatomical locations as found at operation and as directed by preoperative radiology. All patients having undergone endoscopic sinus surgery at Ipswich Hospital undergo a standard post-operative medical regime of oral antibiotics, intranasal steroids and nasal douching.

Questionnaire

The SNOT-22 was used with an additional question requesting the patient to rate their symptom of headache. Patients rated their sinonasal and headache symptoms on a score of 0 (no problem) to 5 (problem as bad as it can be). At operation data was collected regarding demographics, risk factors and operative procedure. A postoperative assessment using the headache

*Received for publication: March 20, 2006; accepted: November 10, 2006

symptom score was made at 3 months and then again at 12 months using a postal questionnaire.

RESULTS

Between August 2003 and August 2005 a total of 83 patients were enrolled into our study. Fifty-eight patients (70%) correctly completed the questionnaire in full preoperatively, at 3 months and a one year post-surgery. The study group consisted of 30 men (52%) and 28 women (48%), with an age range of 18-79 years (median 49 years).

Headache and Facial Pain

Preoperatively 44 patients (76%) described a degree of headache and 42 patients (72%) described a degree of facial pain. Preoperatively 51.7% (30/58) of patients had the same value for headache and facial pain. At 3 months 56.9% (33/58) had the same value and at 12 months 56.9% (33/58) had the same value. Of those with no headache preoperatively, 28.6% (4/14) had facial pain and of those with no facial pain 37.5% (6/16) had no headache.

Of those with headache preoperatively, the headache score improved in 79.5% (35/44) of cases at 12 months. Of those with facial pain pre-op 78.6% (33/42) of cases improved at 12 months. For both facial pain (42.4%, 14/33) and headache (57.1%, 20/35) this improvement was by 1 point on the scale for the majority of patients. Of the 38 cases with both facial pain and headache preoperatively, 16 (42.1%) showed a better result in facial pain, 12 (31.6%) showed a better result in headache and 10 (26.3%) showed the same result in both headache and facial pain.

Headache and SNOT-22

Looking at preoperative headache score in comparison with pre-operative SNOT-22 a moderate correlation can be demonstrated (ρ=0.51 [95% CI: 0.29, 0.68]), there is a weak correlation between the 3-month scores (ρ=0.38 [95% CI: 0.13, 0.58]) and a moderate correlation between the 12-month scores (ρ=0.54 [95% CI: 0.33, 0.70]).

Headache and ESS

Upon considering the specific symptom score for headache, data was analysed in SPSS V13.0 (SPSS inc, Chicago, Il) and StatXact V4.0 (Cytel Corporation, Cambridge, MA). Boxplots were constructed of the symptom scores and the differences in scores between time-points (Figures 1, 2). Descriptive statistics were calculated (Table 1). The Page test for ordered alternatives was used to compare the symptom scores between the different time points. The Page test was used as the symptom scores were ordinal in nature and the time-points were ordered.

Using the Page test for ordered alternatives there was evidence of a decrease in symptom score over time (PA = -4.58, $p < 0.0001$). 10.3% of patients' symptoms got worse from pre-op to 12 months, 29.3% stayed the same and 60.3% were better at 12 months than they were at pre-op.

Table 1. Descriptive statistics of symptom scores and differences in symptom scores

Statistic	PreOp Symptom Score	3 months PostOp	12 months PostOp	Difference (3 months – pre-op)	Difference (12 months – pre-op)	Difference (12 months 3 months)
Percentile 25	1	0	0	-2	-2	-1
Median	2	1	0	-1	-1	0
Percentile 75	3	1	2	0	0	1

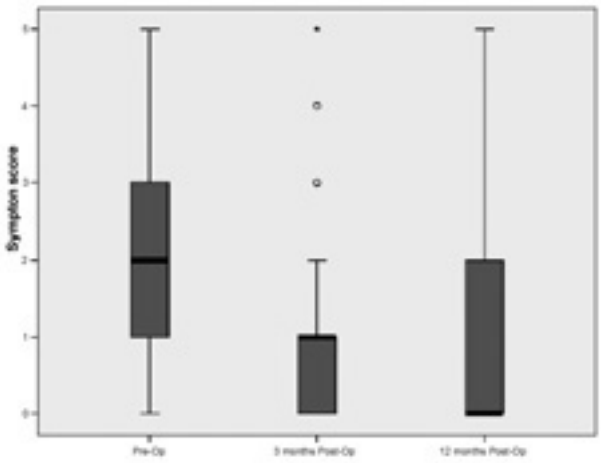

Figure 1. Boxplots of symptom scores at pre-op, 3 months post-op and 12 months post-op.

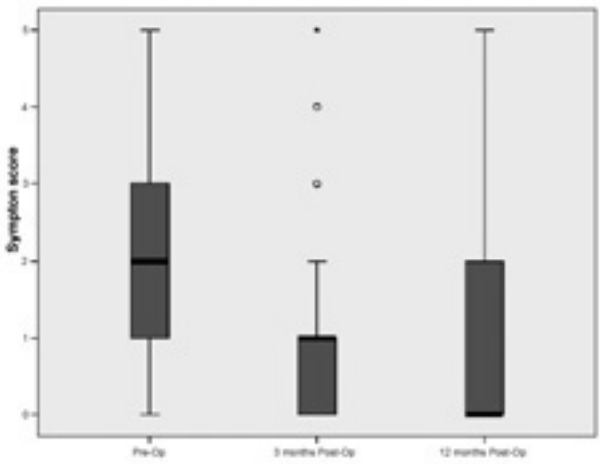

Figure 2. Boxplots of change in symptom scores, from pre-op to 3 months, pre-op to 12 months and 3 months to 12 months.

Headache in Patients with Asthma, Nasal Polyps and Pus

The difference in symptom scores between pre-op and 12 months was compared between those with and without asthma, those with and without nasal polyposis and those with and without pus, this was using the median test (Figures 3, 4, 5).

There was no statistical evidence of a difference in the difference between pre-operative and 12 months scores between those with and without asthma, those with and without polyps and those with and without pus (Table 2).

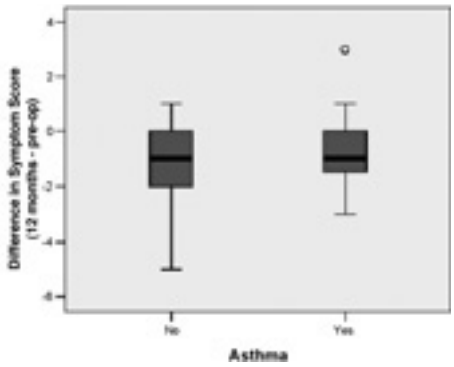

Figure 3. Boxplots of differences in symptom scores from pre-op to 12 months between those with asthma and those without asthma.

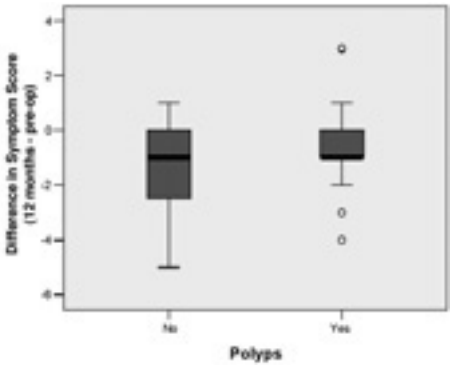

Figure 4. Boxplots of differences in symptom scores from pre-op to 12 months between those with polyps and those without polyps.

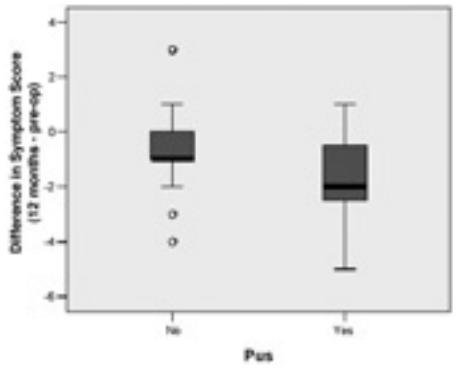

Figure 5. Boxplots of differences in symptom scores from pre-op to 12 months between those with pus and those without pus.

Table 2. Summary statistics and results from Kruskal-Wallis test for subgroup analysis.

Variable	Statistics	No	Yes	Test result
Asthma	N	46	12	
	Minimum	-5	-3	
	Lower quartile	-2	-2	χ^2_{kw}=0.03,
	Median	-1	-1	df=1,
	Upper quartile	0	0	p=0.87
	Maximum	1	3	
Polyps	Valid N	19	39	
	Minimum	-5	-4	χ^2_{kw}=0.77
	quartile	-3	-1	2k
	Upper quartile	0	0	p=0.38
	Maximum	1	3	
Pus	Valid N	43	15	
	Minimum	-4	-5	
	Lower quartile	-1	-3	χ^2_{kw}=1.43,
	Median	-1	-2	df=1,
	Upper quartile	0	0	p=0.23
	Maximum	3	1	

Excluded Patients

The scores between those who dropped out (failed to return a valid questionnaire form) and those who did not were compared using the Mann-Whitney U test in SPSS 13.0 (SPSS inc, Chicago, Il) (Table 3). There is no evidence of a difference in SNOT-22, headache or facial pain scores between those who dropped out and those who did not, however, the SNOT-22 scores tended to be higher and had a slightly larger range for those who were included.

Table 3. Table showing symptom score comparisons between those patients included in the study and those who failed to return a valid questionnaire form.

Score	Category	Included patients (n=58)	Dropouts (n=25)	Comparison
SNOT-22	Median (range)	44 (5, 72)	38 (11, 73)	U=708.5, p=0.87
Headache	0	14 (24.1%)	7 (28.0%)	
	1	11 (19.0%)	4 (16.0%)	
	2	7 (12.1%)	4 (16.0%)	U=701,
	3	12 (20.7%)	4 (16.0%)	p=0.81
	4	10 (17.2%)	4 (16.0%)	
	5	4 (6.9%)	2 (8.0%)	
Facial pain	0	16 (27.6%)	8 (32.0%)	
	1	8 (13.8%)	3 (12.0%)	
	2	6 (10.3%)	5 (20.0%)	U=673,
	3	10 (17.2%)	3 (12.0%)	p=0.60
	4	14 (24.1%)	3 (12.0%)	
	5	4 (6.9%)	3 (12.0%)	

DISCUSSION

The association between the symptom of headache and sinonasal pathology is poorly understood. It is however, important to establish an association if we intend to subject patients to endoscopic sinus surgery in the hope of relieving this symptom. There is much debate regarding the relationship between headache and sinus pathology, with many authors proposing that 'sinus headache' is a manifestation of migraine or some other form of primary headache [1,2]. Many authors and clinicians have gone even further and claimed that 'chronic sinusitis is never a cause of headache' [3] Stammberger and Wolf were one of the first advocates for endoscopic sinus surgery for facial pain and postulated that variations in the anatomy of the nasal cavity resulted in mucus stasis, infection and ultimately facial pain [4]. These hypotheses to-date have not been substantiated. A number of small studies claim successful resolution of facial pain by endoscopic sinus surgery in the absence of endoscopic or CT evidence of sinus disease [5,6], however there is no support for the theories behind these practices and surgical success has been postulated to be the result of placebo effect or cognitive dissonance [7].

The symptoms of headache and facial pain can often be hard to separate by the clinician as much as the patient. We used a well-known and established sinonasal symptom score that has

been appraised for its reliability, validity, responsiveness and ease of use [8]. A number of headache scores exist but in the context of treating 'sinus headache' we found that on completing a score for headache in the context of other sinonasal symptoms, including facial pain, focused the mind of the patient in distinguishing between these two symptoms. Additionally it was possible to compare like values for headache and facial pain during analysis.

Headache and Facial Pain

On completing the symptom questionnaire for the first time help was given regarding how to answer the questions and in particular emphasis was made on how to differentiate the symptoms of headache from that of facial pain. Despite this half (51.7%) scored the same scores, although a significant number of patients had facial pain without headache (28.6%) and a significant number of patients had headache without facial pain (37.5%). At 12 months ESS was beneficial for 78.6% patients with facial pain and 79.5% patients with headache. Similar studies looking at symptoms of facial pain have demonstrated rates of between 56% and 77% after sinus surgery [9,10,11] Mehanna et al. used the Glasgow Benefit Inventory to report the benefit of ESS in different patients and concluded that patients who reported their main symptom as headache reported statistically significant higher benefit than patients reporting their main symptom as facial pain [12].

Headache and SNOT-22

Correlation between headache and SNOT-22 preoperatively, at 3 months and 12 months ranged from low to moderate. It is therefore hard to place headache as a directly associated part of the sinonasal symptomatology. Some patients with CRS have headache but we cannot prove whether headache is a direct result of their CRS or whether headache is an independent and coincidental symptom.

Headache and ESS

In our study 40% of patients continued to have headache symptoms despite endoscopic sinus surgery and this compares well with other studies. Tarabichi concluded from his study that non-sinus pathology accounts for headache in 38% of patients undergoing sinus surgery [13]. Tarabichi went on to analyse the relative prevalence of primary headache (21% of the adult general population)[14], sinusitis (15% of the adult population) [15] and the incidental background findings of mucosal disease (42%) or anatomical variations (65%) on sinus CT scan [16]. Tarabichi concluded that '14% of the population will have incidental association of anatomic variation on sinus CT with primary headache, 8% will have incidental mucosal changes and headache, and 1 in 5 with sinusitis will also have an unrelated primary headache disorder' [13]. Iro et al. conducted a retrospective study of 208 patients who had undergone endoscopic sinus surgery [17]. Ten percent of patients reported headache as their main preoperative complaint with 80% describing 'complete healing' post op and 20% reporting a 'major improvement'. Unfortunately this large study only looked at a small number of patients suffering with preoperative headache and the study was flawed by recall bias due the nature of the retrospective questionnaire.

Headache in Patients with Asthma, Nasal Polyps and Pus

The benefit of endoscopic sinus surgery in patients with asthma and nasal polyposis has been established by a number of studies [18,19,20,21,22]. Garrel et al. demonstrate a reduction in facial pain after endoscopic sinus surgery for nasal polyposis from 36.36% pre-operatively to 4.55% post-operatively ($p=0.001$) [23]. This study was limited, as admitted by the authors, as they only studied patients with nasal polyposis and had no control group with which to compare. Deal and Kountakis [24] evaluated the outcome of endoscopic sinus surgery in patients with nasal polyposis using the Sinonasal Outcome Test (SNOT-20). In contrast to the findings of Garrel et al. [23], they concluded that patients with nasal polyposis showed less improvement after surgical intervention than patients without nasal polyposis. It has been argued that in the absence of purulent secretions, one should be cautious about attributing symptoms of facial pain as being sinogenic in origin. Fahy and Jones examined a large cohort of patients with rhinosinusitis and facial pain and concluded that this relationship is more coincidental and more likely to be results of neurological aetiology [25]. Dejima et al. prospectively analysed the outcome of endoscopic sinus surgery of 88 patients, with or without asthma [26]. The outcomes were significantly worse in the asthma group, although patients suffering from chronic sinusitis and bronchial asthma showed improvement following surgery in terms of their asthma symptoms. The term 'sinogenic headache' infers that headache is the result of sinus pathology. One would therefore expect patient groups with demonstrable sinus pathology, such as nasal polyposis, or risk factors, such as asthma, to gain greater benefit from surgery that is directed at rectifying sinus disease. Our results demonstrated no evidence of a difference in symptom resolution between patients with and without asthma ($\chi^2_{kw} = 0.03$, $df = 1$, $p = 0.87$), or patients with or without nasal polyposis ($\chi^2_{kw} = 0.77$, $df = 1$, $p = 0.38$).

The symptom of headache with respect to acute sinusitis is not contested. Indeed, the international headache society nomenclature committee concludes that headache is not recognized as a symptom of chronic sinusitis unless there is a superimposed acute infection. This is interesting, as we found no evidence of differences in headache symptoms between individuals with or without the finding of pus at operation. This is consistent with the findings of Senocak and Senocak who looked at postoperative headache relief in patients with pus in the nasal cavity [27]. Senocak and Senocak found no statistical relationship between the presence of nasal pus or nasal polyposis and headache relief after nasal surgery. The neuromediator Substance P has been implicated as a triggering factor in 'sinonasal headache', whereby sinonasal pathology triggers the

release of this neuromediator, which is responsible for the associated headache. Stammberger and Wolf have demonstrated that the amount of Substance P within nasal mucosa is inversely proportional to the level of inflammation [28]. Our study certainly found no evidence of improved symptom relief after the removal nasal polyposis. This certainly concurred with the notion that inflamed tissue would in turn lack the concentration of substance P necessary to trigger pain.

Evermore rhinologists are implicating neurological aetiologies in the causation of what was once so easily put down to 'sinus headache' and this has been examined in different cohorts of rhinological patients [29,30]. Recently there has been increasing interest in the concept of midfacial pain [31]. Midfacial segment facial pain is a form of tension-type headache that involves the nasion, beneath the bridge of the nose, either side of the nose, the peri- or retro-orbital regions, or across the cheeks; the forehead and occipital regions are often also affected. Patients often describe a feeling of symmetrical pressure and blockage even in the absence of nasal airway obstruction. Nasendoscopy and CT examination is normal. The aetiology of midfacial pain is uncertain but it has been theorised that this type of pain may be a state of trigeminal neuronal hypersensitivity and pain facilitation [32]. This is of interest as patients with midfacial segment pain may temporarily benefit from ESS only to relapse months later to their preoperative symptoms. An explanation for this phenomenon may be related to a temporary alteration of neuronal activity in the trigeminal caudal nucleus as a result of surgical stimulation.

Limitations

There is a number of limitations that needs to be taken into consideration when analysing the data from this study. 25 patients (30%) did not complete a questionnaire at every stage of this study; 9 patients (11%) failed to return the final questionnaire at one year despite returning their questionnaire at 3 months. We can not speculate as to why these patients did not return the postal questionnaires, however retrospective analysis of their symptoms did not reveal that this group had higher scores for headache, facial pain, of SNOT-22 pre-op. Although we have demonstrated a consistent improvement in the reported severity of headache at one year we cannot predict how well patients will be in the longer term. Often patients with nasal polyposis will have a gradual recurrence of their symptoms as their polyps return [33,34].

The role of imaging in the investigation of sinogenic pain is controversial. No comparison is made with respect to preoperative radiological findings as this study aims to concentrate on the symptoms of headache; the correlation between headache, sinonasal symptoms and radiological findings is often poor [35-37].

This study was uncontrolled, so the findings need to be interpreted cautiously as it is unclear what would have happened to these patients if they had not been treated using ESS, their symptom scores might have improved any way. Despite demonstrating a statistically significant improvement of all patients as a whole, there was no evidence of a difference in outcome between subgroups of patients with nasal polyposis, asthma or pus. This may be due to the fact that there were insufficient numbers for a statistically significant difference to be demonstrated. If our results are indeed representative it would be hard to reach the conclusion that the alleviation of headache was due to improvement of other factors implicated in sinus disease.

CONCLUSION

Undertaking a study to evaluate the benefit of ESS for headache is complex as patients often find it difficult to separate the symptoms of facial pain from the symptoms of headache. Endoscopic sinus surgery is successful in well-selected patient groups. Such patients groups are those with symptoms that match radiological and clinical findings. Patients with facial pain and SNOT-22 symptoms did not convincingly have similar scores for headache. A subset of patients with facial pain, headache and high SNOT-22 did benefit from ESS but the relationship between headache and facial pain, and headache and SNOT-22 could not be substantiated. Whether headache is part of the whole array of sinonasal symptoms or coincidental, ESS seems to be beneficial in both groups of patients. A statistically significant improvement in headache symptom scores was demonstrated at 3 months post-surgery and this improvement was maintained at one year post-surgery. From this study we have found no evidence that headache symptoms in patients with asthma benefit from surgery more than those without asthma. The intraoperative presence of pus was not associated with an improvement in headache symptoms; similarly the intraoperative presence of nasal polyposis was not associated with an improvement in headache symptoms.

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