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Endoscopic sinonasal surgery in the management of primary headaches*

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SUMMARY

Primary headaches (migraine, cluster, tension-type) are common disorders thought to be unrelated to nasal and sinus abnormalities. We present data on 19 patients with refractory primary headaches in the absence of significant sinus symptoms. The majority of patients responded with decreased pain to office application of nasal anaesthesia. A high prevalence of sinonasal abnormalities was found on coronal CT scans. Seventy-nine per cent responded with either decreased pain severity or headache frequency after endoscopic sinonasal surgery. We discuss possible underlying mechanisms to explain these findings.

Key words: headache, endoscopic sinus surgery, nasal, substance P, mucosal contact

INTRODUCTION

Primary headaches, such as migraine, cluster and tension-type, are common disorders thought to be unrelated to any underlying organic pathology, including sinonasal disorders (Headache Classification Committee, 1988). Most clinicians will not entertain the diagnosis of sinus-related headache without obvious sinus symptoms (Campbell and Sakai, 1993). However, some reports suggest that classic sinus symptoms need not be present for headache to be sinus-related (Faleck et al., 1988; Clerico, 1995). Additionally, sinonasal abnormalities can cause referred head pain and associated symptoms identical to those of typical primary headaches (Faleck et al., 1988; Takeshima et al., 1988; Clerico, 1995, 1996). We present 19 patients with refractory headaches and without significant sinus symptoms who demonstrated sinonasal abnormalities on nasal endoscopy and/or CT scan. Endoscopic sinonasal surgery aimed at correcting these abnormalities has resulted in improvement of headache in 15 patients (79%). These findings suggest that undiagnosed sinonasal abnormalities may be responsible for treatment failures in some patients with primary headaches, and that sinus symptoms need not be present or prominent for pain-referring sinonasal pathology to exist.

MATERIAL AND METHODS

We reviewed the charts of 25 consecutive patients presenting to one of the authors (DMC) between July 1992 and January 1995 with the diagnosis of primary headache refractory to standard neurological medical treatment. All patients underwent thorough headache and rhinological history, otolaryngological examination including palpation of the temporomandibular joints, diagnostic nasal endoscopy and CT of the sinuses. Some patients presented with a previous CT scan; otherwise, a sinus CT-scan was obtained only after a minimum 3-week course of broad-spectrum antibiotics and topical nasal steroid sprays. This regimen was used even in the complete absence of sinus symptoms. The rationale was that if patients improved on this therapy, occult sinusitis was presumed to exist. If patients did not respond to this regimen and displayed evidence of sinus mucosal disease on CT scan, radiographical findings were presumed to have surgical significance.

Inclusion criteria were: (1) chief complaint of headache; and (2) no known sinus disease nor significant sinonasal symptoms, such as nasal congestion, recurrent sinusitis, postnasal drip, rhinorrhoea or hyposmia. Upon careful review of symptoms, we elicited from some patients minor nasal symptoms, which they had not previously reported and for which they had not sought medical attention. This series includes three patients who have been previously reported.

When possible, patients were evaluated in the office while experiencing headache pain. Local nasal anaesthesia was administered in at least one of three ways: (1) 2% tetracaine with 1% ephedrine topical spray; (2) 4% liquid cocaine on cotton-tipped applicators; or (3) 0.5% bupivacaine injection. All patients were sprayed with 2% tetracaine/1% ephedrine spray before endoscopic examination. Attempts were made to apply anaesthetic directly to areas of mucosal contact identified endoscopically.

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Patients were asked to score their pain intensity on a 0-10 scale before and after this procedure.

Indications for surgery were headache refractory to previous neurological treatment and one or more of the following: (1) decrease in headache severity after application of local nasal anaesthesia; (2) anatomical variations/abnormalities identified by endoscopy and/or CT; and (3) sinus mucosal disease on CT scan. Anatomical abnormality was defined as a deviated septum, septal spur or concha bullosa of the middle turbinate. Anatomical and mucosal abnormalities were not considered significant unless they were ipsilateral to the side of headache.

Endoscopic sinonasal surgery, when performed, was tailored to the patient's symptoms, nasal endoscopic findings and CT diagnosis. Unlike traditional functional endoscopic sinus surgery, the primary goal of our surgery was to identify and eliminate areas of mucosal contact, in addition to eradicating mucosal disease. Standard post-surgical care included weekly office debridement of the sinus cavities until crusting resolved (usually four weeks), and less often thereafter.

Pre- and post-operative data on headache intensity and frequency were elicited prospectively. Patients were asked to grade headache pain intensity on a 0-10 scale, with "0" indicating no pain and "10" indicating "the worse pain imaginable". Patients were asked to report headache frequency as constant or intermittent, and as number of episodes per day/week/month/year. Data were obtained through abstraction of medical records and telephone interview. In an effort to reduce observer and reporting bias, telephone interviews were conducted by one of the co-authors (DJG), who was not a part of the operating team. Severity scores and frequency data were analyzed using the paired *t*-test.

RESULTS

Of the 25 patients identified, three patients were excluded because of a significant history of sinusitis, two were excluded because of a good response (decreased headache frequency and intensity) on nasal corticosteroid spray, and one patient had neither CT evidence of anatomical abnormalities or sinus disease nor responded to office application of topical anaesthetics with decreased pain. This left 19 patients who underwent ESS specifically for headache relief, comprising 12% (19/158) of this author's total endoscopic sinus surgery caseload during this period.

Patients ranged in age from 18 to 63 years; 15 were female and 4 male. All patients but one had at least one neurological evaluation for headache, with the average being 2.3 prior neurological evaluations. Ten patients were referred to the primary author from neurologists, 8 from a comprehensive headache center. Headache diagnoses included common migraine and *status migrainosis*, tension-type or chronic daily headache, cluster headache, trigeminal neuralgia, a-typical facial pain and post-traumatic headache (Table 1). Four patients had more than one headache diagnosis. Average headache chronicity was 6.1 years; 14 out of 19 patients (74%) suffered with headaches for over two years. Seventy-four per cent reported pain in the supra-orbital region, 37% peri-orbitally, 26% had maxillary pain, 16% each with pain on the nasal dorsum, medial canthus, and temple. Eleven per cent reported pain retro-orbitally and an equal number in the parietal area. Sixty-three per cent characterized the pain as a "pressure" sensation; other terms used were "throbbing", "dull", and "sharp". Sixty-three per cent (12/19) were using narcotic analgesics pre-operatively, and four patients failed in-patient treatment with injectable DHE 45. Two patients had a history of narcotic dependence requiring in-patient detoxification.

No patients reported prominent sinus symptoms. However, on careful review, we elicited from 13 patients one or more of the following symptoms: nasal congestion or obstruction (8/19; 42%), postnasal discharge (8/19; 42%), anterior rhinorrhoea (4/19; 21%), recurrent infection (2/19; 11%), and hyposmia (1/19; 5%). Patients reported in each case that these symptoms were mild. In the two patients with a history of sinusitis, the referring neurologists felt that the chronic headaches were unrelated to these episodic infections. Thirteen patients had previous allergy testing, most as part of the workup for their headaches, and 11 patients (58%) tested positive. Three patients had prior nasal surgery; one had soft tissue repair subsequent to a dog-bite as a child, one had septoplasty, and one had several cosmetic rhinoplasties following a nasal fracture.

No patients had tenderness on palpation of their temporomandibular joints. Nasal endoscopy revealed septal abnormalities in six patients and middle turbinate abnormalities (concha bullosa or paradoxic curvature) in 11 patients. Mucosal contact between the middle turbinate and septum or lateral wall was identified in 12 patients. Seventeen out of 19 patients were evaluated in the office while experiencing headache pain. Thirteen out of 17 patients (76%) responded that pain decreased by at least 50% after nasal anaesthesia; 10 out of 14 patients responded to topical tetracaine spray, 4 out of 5 patients to cocaine application, and one patient to bupivacaine injection. Two patients had more than one type of anaesthesia applied. Two patients did not have headache at the time of any office evaluation, but were nonetheless considered surgical candidates on the basis of CT findings.

Seventeen patients (90%) had abnormal sinus CT-studies defined by either anatomical abnormalities or mucosal disease. Notably, more patients (13/19; 68%) displayed anatomical abnormalities than sinus mucosal disease (9/19; 47%). Forty-two per cent had septal spurs or deviations and 58% had conchae bullosae. Mucosal abnormalities included thickening, complete opacification, and mucus retention cysts. No air-fluid levels were found. Eight out of 13 patients with anatomical abnormalities had no mucosal disease. Five out of 9 patients with mucosal disease on CT scans had no sinonasal symptoms. Eight of the 13 patients with sinonasal symptoms had no mucosal disease on CT scans.

The surgical procedure was individualized for each patient to address mucosal disease and anatomical variations/abnormalities. A total of 28 ethmoidectomies, 13 partial middle turbinectomies, and 7 submucous resections were performed. Middle meatal antrostomies, sphenoidotomies, and frontal sinusotomies were performed at the surgeon 's discretion (either when disease was present in these areas or to prevent post-operative stenosis).

Follow-up ranged from 1 month to 40 months, with a mean of 21 months. Fifteen patients (79%) reported improvement in

Table 1. Individual patient data.

patient	age	gender	headache diagnosis	chronicity	pre-op severity	pre-op frequency	post-op severity	post-op frequency
1	38	male	status migrainosis	17 yrs	8	daily	1	q 3 mos
2	18	female	status migrainosis	5 yrs	6	daily	0	0
3	49	female	trigeminal neuralgia	5 wks	10	daily	0	0
4	56	female	common migraine	14 yrs	8	q 2 weeks	2	q 3 mos
5	38	female	common migraine	7 yrs	10	daily	3	2 d/wk
6	31	female	post-traumatic	2 yrs	5	daily	0	0
7	26	female	atypical facial pain	15 mos	7	daily	7	5 d/wk
8	25	male	tension-type	1 yr	7	daily	1.5	5 d/wk
9	26	female	mixed (tension/migraine)	10 yrs	4	daily	3	daily
10	63	female	common migraine	15 yrs	7	daily	1	monthly
11	32	female	atypical facial pain	5 mos	5	daily	0	q 2 mos
12	51	female	status migrainosis	7 yrs	6	daily	0	0
13	38	male	cluster	14 yrs	10	several times a day during cluster; clusters q 3 mos	2	daily
14	34	male	atypical facial pain	15 mos	6	daily	6	daily
15	35	female	atypical facial pain, common migraine	6 yrs	8	daily	10	daily
16	38	female	common migraine, trigeminal neuralgia	2 yrs	5	daily	5	daily
17	33	female	atypical facial pain, common migraine	4 yrs	9	daily	9	daily
18	49	female	common migraine	7.5 yrs	8	weekly	4	1 q mos
19	18	female	tension-type	2 yrs	8	daily	5.5	daily

(headache severity on 0-10 scale)

headache severity or frequency. Average pre-operative pain severity was 7.2 (0-10 scale). Post-operatively, average pain severity was 3.1 for all patients; 1.9 for responders and 7.5 for non-responders. Pre-operatively, patients reported an average of 6.3 headache days per week. Post-operatively, headache frequency averaged 3.2 days per week; 2.3 days for responders and 7.0 for non-responders. Data is summarized in Tables 1 and 2. The improvements in severity and frequency for the group as a whole were both statistically significant ($p<0.001$).

Characteristics of responders and non-responders were evaluated. No significant differences were found in age, gender, neurology evaluations, headache type, headache chronicity, frequency, severity, location, analgesic use, allergy evaluations, sinonasal symptoms, objective rhinological findings, response to nasal analgesia, and length of follow-up. Three non-responders reported decreased pain intensity after nasal analgesia. One non-responder whose pain did not decrease after nasal anaesthesia, had mucosal disease on CT scans.

Table 2. Headache characteristics pre- and post-operatively.

	pre-op severity	post-op severity	pre-op frequency	post-op frequency
all patients	7.2	3.1	6.3	3.2
responders	7.2	1.9	6.2	2.3
non-responders	7.0	7.5	7.0	7.0

(headache severity on 0-10 scale; headache frequency in days per week)

DISCUSSION

The relationship between headache and sinonasal disorders is well established. However, the character and clinical presentation of sinus-related pain are thought to differ significantly from primary headaches. The *International Headache Society* criteria requires the presence of nasal and/or sinus symptoms (congestion, obstruction, discharge) for the diagnosis of sinus-related headache (Headache Classification Committee, 1988). Primary headaches (such as migraine, cluster, and tension-type) are so named because no underlying organic pathology has been associated with the constellation of symptoms defining each headache type.

The phenomenon of referred headache secondary to nasal pathology was recognized centuries ago. The earliest reference we could find dates back to 1728 when Wepfer noted that headaches could be caused by nasal obstruction (cited in Wells, 1898). Roe (1888) described a patient with severe, migraine-type headache without nasal symptoms. Deviation of the nasal septum was found on examination and the headache resolved after submucous resection. In the early 1900s, Sluder (1927) popularized the concepts of sphenopalatine ganglion neuralgia and vacuum headaches. During the 1940s, Wolff (cited in Wolff, 1963) performed experimental studies mapping patterns of referred pain induced by various stimuli applied to the sinus and nasal cavities. Stammberger and Wolf (1988) postulated that mucosal contact could cause headache via substance P (SP) release from the nasal mucosa. SP is a neuropeptide, a potent vasodilator, and probable mediator of painful sensation (*vide infra*). They found that normal mucosa has higher concentrations of SP (and therefore is presumably more pain-sensitive) than chronic hyperplastic mucosa or polyp tissue. In theory, then, contact between mucosal surfaces in the nose would elicit more pain than chronic infection or inflammation. Typical nasal/sinus symptoms would not be expected in this situation.

The trigeminovascular system provides the anatomical and physiological basis for referred pain from the sinonasal tract. Terminal branches of the ophthalmic and maxillary divisions of the trigeminal nerve innervate the nasal and sinus cavities. Sensory nerve fibres of the C-fibre type (responding to noxious stimuli) are found in the epithelial and subepithelial layers. When depolarized by chemical, thermal, inflammatory or mechanical stimuli, these nerve terminals release neuropeptides, among which is SP, calcitonin-gene-related peptide (CGRP) and neurokinin A (NKA). The remainder of this discussion will be limited to SP, since it is the most-studied of the neuropeptides. SP is released not only at the site of stimulation, but centrally and at the terminals of collateral axons as well. Branches of the trigeminal (mostly ophthalmic division) innervate the dura and intracranial blood vessels. When SP is released at perivascular sites, neurogenic inflammation with resultant vasodilation, plasma extravasation and leukocytic infiltration can ensue. This vasodilation and perivascular inflammation is the final common pathway in migraine pain. The mechanism is known, therefore, whereby sinonasal pathology may excite central pain pathways leading to migraine.

The SP content of various tissues may help to explain the referred pain phenomenon. For instance, the intracranial vasculature has higher SP concentrations than extracranial cephalic vessels (Norregaard and Moskowitz, 1985) in some animal species. These intracranial vessels would presumably be more pain-sensitive than the nasal cavity, explaining why sinonasal pathology may present as vascular-type headache.

The variety of headache presentations in this series suggests no one description of pain character or quality will suffice to predict sinonasal pathology. The common feature to all headaches is activation of the trigeminovascular system. An initial impulse in the sinonasal tract may be routed to different end-target tissues, which can determine the clinical presentation. If cranial blood vessels are the target tissues, migraine headache may predominate. If the dura or scalp musculature receive these impulses, tension-type or chronic daily headache may be the presentation. SP-containing sensory nerve terminals are found densely surrounding parasympathetic neurons in the sphenopalatine ganglion (Lundblad et al., 1983). Therefore, noxious stimuli in the nasal cavity may also produce the autonomic signs that characterize cluster headaches (lacrimation, rhinorrhoea, nasal congestion, et cetera).

Four patients failed to improve with surgery. Interestingly, three of these reported decrease in headache severity after the application of nasal anaesthesia in the office setting, indicating this technique cannot be relied upon solely to diagnose rhinopathic headaches. Whether this finding represents a placebo effect, or surgery simply "missing" the involved area is not known. Repeat CT scans obtained post-operatively may have helped clarify the issue.

Obviously not all subjects with mucosal contact have headaches, just as a large percentage of subjects with sinus CT abnormalities have no sinus symptoms (Calhoun et al., 1991). It is likely that peripheral and central pain modulating mechanisms determine clinical symptomatology. For example, all airway mucosa contains neutral endopeptidase (NEP), an enzyme that degrades SP. This SP-degrading action of NEP may be unaffected by limited areas of mucosal contact, where epithelial damage is not significant. However, as the duration or area of contact increases, epithelial damage may progress so that NEP concentrations decrease, epithelium is lost, and basement membrane (which contains a greater number of afferent nerves) exposed. These factors may then combine to produce the clinical symptom of headache. Central pain modulating factors may also play a role in the headache patient. The pain message can be influenced by central processing mechanisms that depend on attention, cognition, emotional state (Melzack and Wall, 1965), and other factors.

Two recent reports relating to this study bear mentioning. Chow (1994) reported on 18 patients with headache but without mucosal disease on CT. Various anatomical variations/abnormalities were found and believed to be the cause of pain. Fourteen out of 17 patients (82%) who underwent endoscopic surgery, reported cure or significant improvement. The author does not give details of headache characteristics, previous neurological workups or attempted therapies. None of the patients

reported headache as their chief complaint, in contrast to our series of patients. Despite the fact that our patients had more severe headaches, our success rate is comparable. Chow's series further demonstrates that sinus mucosal disease need not be present for referred headache to originate from the sinonasal tract. Cook et al. (1994) reported on 18 patients who underwent limited endoscopic surgery (uncinectomy, middle meatal antrostomy and partial middle turbinectomy) for complaints of recurrent sinusitis with headache/facial pain but who had normal CT scans. Reduction in symptom scores were reported by 14 out of 18 patients (78%). Interestingly, the 3 patients diagnosed with migraines did not improve after surgery. No mention was made of mucosal contact areas. Since the resection was standardized and limited, areas of mucosal contact may not have been addressed, providing a possible explanation for why these 3 patients failed to improve. Cook's report demonstrated that endoscopic surgery may be appropriate in those few patients who have significant sinus symptoms, including headache/facial pain, despite no objective disease on CT.

The headache relief reported by the responders in this series proved to be long-lasting (mean 21-month follow-up), unlike the experience of some other experienced endoscopic surgeons (Kuhn, personal communication; Stankiewicz, personal communication). This may be the result of our deliberate intent to identify and eliminate areas of mucosal contact (especially septal-turbinate contact) seen on CT. These areas, which mostly lie outside the ethmoid cavity, are not addressed with conventional endoscopic sinus surgery.

It should be noted that the typical patient in this series was one with chronic, debilitating and refractory headaches who had on average 2.3 prior neurological evaluations and who failed standard abortive and prophylactic medical regimens. Ninety per cent had "abnormal" sinus CTs, with either anatomical abnormalities, mucosal disease of both. Therefore, in no way do we suggest that ESS should be adopted as first-line therapy for headaches, or that ESS should be performed on patients with normal CTs. Rather, the findings in this series suggest that previously undiagnosed sinonasal pathology may be a frequent cause of refractory primary headache symptoms, in which case ESS is an effective therapeutic modality.

CONCLUSION

We performed endoscopic sinonasal surgery on a series of patients with a variety of diagnosed primary headaches thought to be unrelated to any underlying sinonasal disease. Previous neurological therapies failed to control their head pain. A variety of rhinological abnormalities were identified on diagnostic nasal endoscopy and coronal sinus CT-scanning, despite the absence of significant sinus symptoms. Surgery resulted in alleviating or lessening pain severity and headache frequency in the majority of cases. These findings suggest that sinonasal abnormalities can masquerade as primary headaches. Some patients with refractory primary headaches may benefit from the workup and treatment of their previously undiagnosed rhinological disorders.

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