Frequency of Sinus Disease in Normal Subjects and Patients with Benign Paroxysmal Positional Vertigo

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Abstract

Background/Aims: To determine if patients with benign paroxysmal positional vertigo (BPPV) have a higher frequency of rhinosinusitis than people with normal vestibular function. **Methods:** The subjects were 52 patients with BPPV and 46 normal people. Every subject had a sinus CT scan, a blood draw for IgE and a rhinologic examination by an otolaryngologist. **Results:** The frequency of rhinosinusitis based on physician diagnosis was 49% and based on CT scan findings 59%. This difference approached significance ($p = 0.08$). The observed frequency of rhinosinusitis was higher than predicted by survey data about the southern US region. The data trended toward higher prevalence of rhinosinusitis (by physician diagnosis) in the BPPV patients versus controls (58 vs. 39%, $p = 0.06$). **Conclusion:** BPPV patients have a higher frequency of sinus disease compared to people with normal vestibular systems, perhaps due to age differences, but physiologic factors may also be involved. The higher frequency of rhinosinusitis in this geographical area than reported rates based on survey data raises concerns about the usefulness of questionnaire data for estimating population prevalence.

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Introduction

Some evidence in the literature hints at a relationship between vestibular disorders and sinus disease. In his review of the literature prior to 1969, Coats [1] described 5 papers or commentaries that mentioned an association of sinus disease with vestibular neuronitis. Dix and Hallpike [2] reported that 20% of patients with vestibular neuronitis had sinus disease. In the same paper, they reported that a few patients with positional vertigo (the exact number was not specified) had sinus infections. Haid [3] reported 30 cases with sinus disease who also complained of vertigo although the exact nature of the vestibular impairment was not stated. Cohen et al. [4] reported that when patients with benign paroxysmal positional vertigo (BPPV) were queried about the health histories, 56% of patients reported symptoms of rhinosinusitis or upper airway disease, e.g. discolored mucus, nasal congestion or cough. Those data were obtained from interviews and responses to a questionnaire but the subjects were not examined by an otolaryngologist to determine if they actually had rhinosinusitis. No other studies in the literature have examined the relationship between these types of problems.

According to the federal government, the prevalence of rhinosinusitis in noninstitutionalized adults in the general population is 14%, and for the southern region

the current prevalence is 16.9% [5]. Data specific to smaller localities were not available. A weakness of those findings is that the data were obtained by questionnaire and subjects were not examined by otolaryngologists or given CT scans. Therefore, the true prevalence is unknown. The frequency of endoscopic sinus surgery for chronic rhinosinusitis – in patients who would have been diagnosed and treated by qualified surgeons, probably otolaryngologists – may be more accurate. When broken down by 4 geographic regions, the southern region had more cases of endoscopic sinus surgery than other regions [6].

Rhinosinusitis was defined as ‘symptomatic inflammation of the paranasal sinuses and nasal cavity’ [7]. We measured the frequency of rhinosinusitis using a standard system, regardless of the extent of disease, in our limited geographical area and tested the hypothesis that patients with BPPV would have a higher rate of rhinosinusitis than normal subjects.

Methods

Subjects were a convenience sample of 98 volunteers, including 46 normal subjects with no complaints of vertigo or disequilibrium and no history of sinus surgery, or vestibular, neurological or orthopedic disorders. They were recruited from among staff, visitors to our institution (usually family members who accompanied patients) and volunteers from the community. The other 52 subjects were patients with unilateral BPPV, who had been diagnosed by their physicians based on Dix-Hallpike tests, positional tests and any other tests that the referring physicians might have considered necessary. The total sample had 23 males and 75 females, mean age 52.7 years (SD = 14.9, range 23.3–83.0). BPPV patients were somewhat older (mean age 58.3 years) than healthy controls (mean age 46.5 years; $p < 0.001$). All patients were recruited from the caseload of one author (H.S.C.) when they were referred for vestibular rehabilitation. Patient subjects were participants in a study of treatments for BPPV; they represent a subsample who had no history of having had endoscopic sinus surgery and who were willing to participate in the additional testing in this study.

All subjects were given sinus CT scans at the same diagnostic laboratory. Radiologists who were not otherwise involved in the study read the films and graded the presence and severity of CT findings using the Harvard scale. The Harvard system stages disease from 0 to 4: 0 = normal with <2 cm thickening on the wall of any sinus; 1 = unilateral disease; 2 = bilateral disease of only the ethmoidal or maxillary sinuses; 3 = bilateral disease also involving at least 1 frontal or sphenoidal sinus; 4 = bilateral disease affecting all or almost all sinuses [8]. Every subject had a blood draw to test for the presence of IgE as an indicator of the presence of allergy. The subjects were all examined by board-certified otolaryngologists on the full-time or clinical faculty. The 4 faculty otolaryngologists who saw most subjects were well qualified; they had a mean experience after residency of 8 years (SD 4.1). All of them practice general otolaryngology; 2 of them are also facial

plastic surgeons, 1 is also a rhinologist and 1 has a background in research in rhinosinusitis. For every subject, the otolaryngologist performed a rhinologic examination and completed a standard questionnaire based on current recommendations for diagnosis [9]. The diagnosis of rhinosinusitis was made by the clinician, based on a combination of symptoms, physical examination findings and CT findings (see the Appendix for the rhinologic examination form). For example, a patient with no symptoms, normal physical examination and minimal change on the CT scan would be graded as ‘no sinonasal disease’, and a patient with a few symptoms, normal physical examination and normal CT scan would also be graded as ‘no sinonasal disease’.

All subjects gave informed consent prior to participation. This study was approved by the Institutional Review Board for Human Subject Research for our institution.

Patients and healthy controls were compared via Student’s *t* test, χ^2 analysis or McNemar’s test. Multivariate logistic regression analysis was performed for the estimation of odds ratios and corresponding 95% confidence intervals, adjusting for possible confounders. All comparisons were two sided. A *p* value <0.05 was considered statistically significant. All analyses were performed using the SAS System statistical software (SAS, Cary, N.C., USA).

Results

BPPV patients were significantly older than healthy controls (46.5 vs. 58.3 years, $p < 0.001$). The normal range of IgE was considered 0–180 IU/ml. Mean IgE levels $\pm$ SD were 93.4 ± 277 and 74.8 ± 164 for BPPV patients and normal subjects, respectively ($p = 0.69$; table 1).

When rhinosinusitis was diagnosed by the otolaryngologists, the overall prevalence of rhinosinusitis in both groups was 49%, and the data showed a trend toward a higher prevalence among BPPV patients than healthy controls (58 vs. 39%, $p = 0.06$). Based only on the CT scan findings showing a Harvard stage of 1 or higher, 59% of subjects had evidence of rhinosinusitis, and the BPPV patients and healthy controls did not differ significantly (57%, normal subjects; 62%, BPPV patients; $p = 0.6$; table 1).

In addition to the univariate analysis, we performed multivariable regression analysis to identify independent associations. Overall, in that analysis, odds for having sinus disease were more than twice higher among patients with BPPV than healthy controls, and this trend was independent of possible confounders (adjusted odds ratio = 2.39; 95% confidence interval = 0.97–6.11; $p = 0.06$; table 2). Next, we examined the level of agreement between physician and CT Harvard score on the diagnosis of sinus disease. Otolaryngologists diagnosed sinus disease less frequently than the CT scan, alone, and these results approached significance (49.0 vs. 59.2%, respectively, McNe-

Table 1. Description of BPPV patients and healthy controls (%)

	Normal (n = 46)	BPPV (n = 852)	p value
Gender			0.92
Male	24	23	
Female	76	77	
Harvard scale of sinus disease	56.5	61.5	0.61
Physician diagnosis of sinus disease	39.1	57.7	0.06

mar's test = 2.9, $p = 0.08$). The level of agreement between the two tests was generally low ($\kappa = 0.31$). Subjects with rhinosinusitis, as diagnosed by otolaryngologists, were slightly but not significantly older than subjects without sinus disease (54.8 vs. 50.7 years; $p = 0.16$). Because we were interested in the general prevalence of rhinosinusitis and not in the various subtypes, all sinus disease was grouped together for the CT results and the otolaryngologist's diagnosis.

Participants were asked if they had a history of sinus disease by their own symptoms. Self-reported symptoms of rhinosinusitis were significantly less frequent in males (34.8%) than females (61.3%; $p = 0.025$).

Discussion

The odds ratios in the multivariate analysis suggest that the prevalence of rhinosinusitis is more than twice as high in patients with BPPV than in people with normal vestibular function. This finding supports the findings in a previous report [4]. The reason for this difference is unknown. Age, for which we adjusted, might be a factor. Physiologic factors might also be involved. This issue should be a fruitful area for future research.

The finding that otolaryngologists diagnosed sinus disease at a lower rate than the CT scan, alone, supports previous research showing that not all abnormalities found on CT scans indicate rhinosinusitis [10–12]. This finding supports the need for expert clinical evaluation. The otolaryngologists had more data available than the radiologists, including a detailed history and physical examination. Furthermore, clinicians use clinical reasoning skills, including tacit knowledge of subtle cues about patient presentation [13–15] that are important in diagnostic decision-making.

These data suggest that the frequency of sinonasal disease, in general, at least in the upper Texas Gulf coast vi-

Table 2. Odds for rhinosinusitis by otolaryngologist diagnosis for BPPV patients compared to healthy controls

	Odds ratio	95% CI	p value
Univariate	2.12	0.95–4.82	0.06
Adjusted ¹	2.39	0.97–6.11	0.06

CI = Confidence interval.

¹ Odds ratio adjusted for age and race.

cinity, might be higher than indicated by the population-based survey data for the southern region [5]. This difference highlights the value of testing individuals rather than relying on questionnaire data. Health histories may be inaccurate because people may remember or report their symptoms or histories inaccurately. Furthermore, regional differences in rhinosinusitis are well established. In the National Health Interview Survey, the prevalence rate was indeed higher in the South than in other regions. Smith et al. [16] showed a similar finding from data on the number of ambulatory care visits, and they suggested that the increased prevalence may be due to higher rates of allergies and allergic fungal rhinosinusitis. In light of regional differences, differences in smaller localities within the region are also likely. Thus, near the Texas Gulf coast with exposure to the petrochemical industry, local molds and pollens, and almost constant, warm, humid weather, the local prevalence might be higher than other areas in the southern USA. These differences are important for planning health care resources by federal, state and local government authorities and health care providers.

Smith et al. [16] and the National Health Interview Survey [5] reported a higher rate of sinus disease in females than males. Our data confirm their findings. Other evidence, however, suggests no gender differences [16]. Therefore, further research is needed to resolve this discrepancy. Women and men are known to report different symptoms of rhinosinusitis [17]. The reasons for these differences remain unclear.

Our study adds some additional evidence to the observations of higher prevalence of sinonasal disease in patients with vestibular dysfunction. In this study, the diagnoses of vestibular dysfunction and sinonasal disease were clearly established, and the goal of the study was to evaluate this potential association. Prior studies used less stringent criteria for diagnosis or were secondary data analyses of data gathered for other reasons. Nevertheless,

our study only identifies a cross-sectional association, and we cannot make assumptions about cause or effect based on that.

To postulate any causative mechanism in either direction (vestibular causing sinonasal, or sinonasal causing vestibular) would be difficult, since the possible mechanisms of a relationship between vestibular function and

sinonasal inflammation are not clear. As a cofactor, however, sinonasal disease may cause more awareness of vestibular dysfunction or vice versa. This relationship needs further study. Our association did not reach statistical significance but it approached significance. A larger sample size may have yielded significant differences.

Appendix: Rhinosinusitis Examination

History

Are sinonasal symptoms present? Yes/No

If 'yes', then complete symptom list; if 'no', move to examination

Duration of symptoms (<3 weeks, 3–12 weeks, >12 weeks)

Symptoms (check all reported)

Facial congestion

Nasal obstruction/blockage

Purulent rhinorrhea

Hyposmia/anosmia

Facial pain/pressure

Headache

Cough

Fever

Halitosis

Dental pain

Ear pain/pressure

Fatigue

Examination (if present, note right or left side)

Nasal examination (anterior inspection and the middle meatus)

Normal examination right/left

Congestion

Discharge

None

Clear and thin

Purulent and thick

Polyps

None

Middle meatus only

Beyond middle meatus

Crusting/dried mucus

None

Mild

Severe

CT scan (list Harvard stage: 0, 1, 2, 3, 4)

Clinical diagnosis (check one)

No rhinitis or sinusitis

Allergic/inflammatory rhinitis without infection

Infectious acute rhinitis

Infectious chronic rhinosinusitis

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