Chronic rhinosinusitis patients with polyps or polypoid mucosa have a greater burden of illness


ABSTRACT

**Background:** Recent studies suggest chronic rhinosinusitis without nasal polyposis (CRSsNP) and CRS with nasal polyposis (CRSsNP) represent distinct pathological entities. The aim of this study was to determine whether patients with CRSsNP, CRScNP, and polypoid CRS could be distinguished by clinical features, radiologic extent of disease or use of medications.

**Methods:** New patients with CRS (n = 126) were enrolled in a prospective outcomes study. Rhinoscopic evaluation was used to classify patients. The relationship between disease phenotype and clinical parameters was examined.

**Results:** Facial pain/pressure/headache was more prevalent in CRSsNP than CRScNP (p = 0.01). Nasal obstruction and hyposmia/anosmia were more prevalent in CRScNP than CRSsNP (p = 0.025 and 0.01, respectively). Intermediate symptom prevalence was found in polypoid CRS. Multivariate analysis confirmed that prior surgery, CT scan score, and male gender were independent predictors of poly/polypoid phenotype. Allergic status was unrelated to CRS classification. Medication use was higher in CRScNP patients than in CRSsNP patients.

**Conclusion:** Compared with CRSsNP, patients with CRScNP have a greater burden of symptoms, more prior surgery, higher CT scan scores, and greater use of medications.


**Key words:** Allergic rhinitis, burden of illness, chronic sinusitis, nasal polyps, outcomes, rhinoscopy, study

Chronic rhinosinusitis (CRS) is a complex disorder that remains poorly understood and difficult to treat. The presence of nasal polyps or polypoid mucosa further complicates the treatment of this disease. Current treatment modalities aim to reduce mucosal inflammation, decrease symptoms, and control infection and include local or systemic steroids, nasal lavage with isotonic saline, and systemic antibiotics. Functional endoscopic sinus surgery (FESS) is the gold standard of treatment in patients with symptoms refractory to medical treatment.

Recent literature suggests that CRS without nasal polyposis (CRSsNP) and CRS with polyposis (CRSsNP) may represent distinct clinical and pathological subtypes of CRS. Evidence is obtained from studies showing histopathological differences between these conditions and clinical studies showing a higher rate of relapse in patients with CRSsNP after either surgical or medical therapy. However, comparative studies of CRSsNP and CRSsNP are relatively sparse. More importantly, there is little information on the clinical features of patients with “polypoid mucosa” in the absence of frank polyposis, a condition that might represent an early stage of CRSsNP. Given these limitations, we wished to determine, in an unselected population of CRS patients, the degree to which CRSsNP, CRSsNP, and polypoid CRS could be distinguished. Our hypothesis was that they would be distinguishable in terms of one or more of the following: clinical symptoms, allergic history, skin testing results, radiographic appearance, or extent of medication use over a prolonged period of observation.

We tested our hypothesis by analyzing data from an outcomes study of CRS conducted in our institution. This study used standardized data collection instruments and serial rhinoscopic examinations to collect baseline information and monitor patients’ symptoms, extent of mucosal disease, and medication usage over a 1-year period.

MATERIALS AND METHODS

**Study Population**

This study was conducted in the Allergy/Immunology and Otolaryngology Clinics at Washington University School of Medicine. Between November 1999 and December 2002, all patients who were new to our clinic with symptoms compatible with the diagnosis of CRS were invited to participate. Patients were seen a minimum of 2 times up to a maximum of 16 times over the 1-year period. There was one allergist/immunologist (D.L.H.) and two otolaryngologists (S.E.T. and J.F.P.) involved. Each physician saw a separate group of patients and made all decisions regarding treatment, and the results were pooled. Approval for this study was obtained from the Washington University Institutional Review Board.

**CRS Criteria**

Patients were required to have two or more major factors or one major and at least one minor factor for CRS with clinical symptoms lasting at least 12 weeks for enrollment in the study. Patients indicated which of four major (facial pain/pressure/headache, nasal obstruction, nasal purulence/discharge, and hyposmia/anosmia) and four minor (fever, hali-
Questionnaires

Each subject completed an initial comprehensive data form that included demographic information, smoking history, questions about overall health, duration of symptoms of CRS, overall amount of disturbance or “bother” that the patient was experiencing in life as a result of CRS; current medications, use of antibiotics, oral steroids, and immunotherapy before the initial evaluation; and history of sinus surgery.

Subjects also completed an initial Sino-Nasal Outcome Test 20 (SNOT-20) questionnaire form (see Fig. 1 for SNOT-20 criteria). Difficulty with sense of smell was made an addendum to the SNOT-20 questionnaire, and the resulting instrument was referred to as the “SNOT-20 + 1” questionnaire. Data from these forms were used to define the burden of illness in the study population. In addition, subjects completed a monthly symptom SNOT-20 + 1 and medication use form and returned them by mail. (A detailed analysis of the patients’ responses to the monthly SNOT-20 + 1 form is the subject of a forthcoming separate report.) Subjects also were asked to complete these same forms whenever they returned to the clinic within the 1-year period. Adequate longitudinal data to assess intensity of medical treatment were obtained for 91 patients.

Evaluation

At the first visit, an Initial Physician form was completed by the physician. This recorded inclusion (major and minor factors for CRS described previously) and exclusion criteria (pregnancy, immunodeficiency, and history of facial trauma), prior medication and immunotherapy treatment history, prior history of sinus surgery, current antibiotic and oral steroid treatment, comorbidities, physical exam (appearance of the inferior turbinate, response to decongestant, nasal discharge, and presence of nasal polyps), and other related rhinologic conditions (rhinitis, moderate to severe asthma per the National Heart, Lung, and Blood Institute guidelines, and atopy). A sinus CT scan was performed on each patient during the initial visit. The anterior ethmoid, posterior ethmoid, osteomeatal complex, maxillary sinus, frontal sinus, and SM were evaluated. Each CT scan was scored for extent of disease using the Lund-Mackay scoring system. All patients who previously underwent the Caldwell-Luc procedure were excluded. A rhinoscopic examination was performed also at the initial visit including assessment of the SM; turbinate size; middle meatus; sinus cavities (in patients with prior sinus surgery); and the presence or absence of edema, mucus or purulence, and polyps or polypoid mucosa in each sinus area. Polypoid was defined as an area of raised edematous mucosa that appeared distinct from the adjacent normal mucosa. The rhinoscopic examination was repeated at each follow-up visit.

Patients seen in the Allergy/Immunology clinic (n = 47) underwent allergy skin testing by standard prick techniques to a panel of pollens (7 trees, 7 grasses, and 7 weeds) and perennial allergens (mite *Dermatophagoides pteronyssinus*, mite *D. farinae*, cockroaches, 15 species of molds, cat, and dog). Intradermal skin tests to the perennial allergens were performed also, and patients were classified based on whether they had positive or negative skin tests.

Prospective Data Collection over the 1-Year Outcomes Study

Although the goal was to collect information prospectively over a 1-year period, not all subjects continued to submit the monthly data forms. A total of 91 patients submitted data forms for at least 150 days (5 months). This subset (73% of the original 126 patients) was used to determine the intensity of medical treatment given for CRS. Standard guidelines were

![Figure 1. Prevalence of symptoms reported on the SNOT20+1 questionnaire at study entry in the entire study population (n=126).](image-url)
not created for antibiotic and oral steroid treatment, because the goal was to show a true representation of outcomes in a university-based subspecialty clinic.

Statistical Analysis

Patients were first classified as having polyp, polypoid, or nonpolypoid CRS. The prevalence of clinical characteristics in the polyp, polypoid, or combined polyp/polypoid group was then compared with the nonpolypoid group using the chi-square test (univariate test). Student’s t-test was used to compare continuous variables across study groups; p = 0.05 was regarded as statistically significant. Stepwise logistic regression was used to determine a best set of independent predictors of polyp/polypoid phenotype using all factors that were statistically significant by univariate analysis as potential predictors in the model. Univariate chi-square analysis was used also to compare medication use in the nonpolypoid, polypoid, and polyp groups.

Chi-square (Fischer’s exact test if n < 5) was used also to analyze the prevalence of polyps, polypoid changes, and combined polyps/polypoid changes; mucus/purulence and edema in the middle meatus/osteomeatal unit (MM/OMU); and sphenoid recess (SM) in the following groups:

1. Sinus surgery versus no prior surgery (for n = 126)
2. Skin test positive versus skin test negative (based on skin-tested subset of n = 47)

Antibiotic and oral steroid use was compared also in the nonpolypoid versus polypoid versus polyp groups for the 91 patients who completed the medication use data form for 150 days. Because the data distributions for antibiotic and oral steroid use were not normally distributed, the Mann-Whitney U test was used for this analysis.

RESULTS

Study Population

The study originally enrolled 130 patients. However, two patients did not sign the consent form and initial patient information was not obtained on two other patients, therefore resulting in a total study group of 126. A total of 91 patients submitted data forms for at least 150 days, and this subgroup of patients was used to determine the intensity of medical treatment given for CRS over the first 150 days of observation.

The patient population had a slightly higher number of women (59%) with the largest group being between 40 and 64 years of age (53%). The mean age was 46 years with an SD of 13.6. The youngest person was 18 years old and the oldest person was 79 years old, giving a range of 61 years. Only 10% of the patients were ≥65 years old. The study group was predominantly white (86%) with 8.7% African American, 1.6% Asian, and 1.6% Hispanic. Thirteen percent of patients were current smokers (Table 1).

Burden of Illness

Data from the initial visit questionnaires were used to define the burden of illness in the study population. All patients fit entry criteria with two or more major factors. Evaluation of the SNOT-20 + 1 questionnaire and scores revealed that postnasal discharge, thick nasal discharge, facial pain/pressure, waking up tired, fatigue, need to blow nose, and lack of a good night’s sleep were the most common complaints among the patient population. The three most common symptoms were closely aligned with the actual diagnostic criteria for CRS (postnasal discharge, thick nasal discharge \( \sim \) nasal purulence/discharge; facial pain/pressure \( \sim \) facial pain/pressure/headache; nasal obstruction \( \sim \) need to blow nose). The other “major” CRS criterion, hypomia/anosmia, was present in 22% of patients. Other symptoms identified in the SNOT-20 + 1, such as “wake up tired,” “lack of a good night’s sleep,” and “fatigue” suggested that CRS was having a significant impact on patients’ quality of life, consistent with our previous findings9 and that of Bhattacharya10 (Fig. 1).

Medication Use at Initial Visit

Data were collected at the initial visit for daily medications being used for treatment of CRS. Approximately one-half of the patients reported using some medications at the initial visit, including 26% using one medication and 24% using two or more daily medications. Altogether, 84% reported having received oral steroids at some time for CRS. Of these patients, 94% believed that steroids were helpful for their symptoms. Immunotherapy was being used by 11% of the patients.

Table 1  Study population characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total Population (n = 126)</th>
<th>Nonpolyp/Polypoid (n = 85)</th>
<th>Polyp (n = 21)</th>
<th>Polypoid (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>52 (41.3)</td>
<td>30 (35.3)</td>
<td>16 (76.2)</td>
<td>6 (30)</td>
</tr>
<tr>
<td>Female</td>
<td>74 (58.7)</td>
<td>55 (64.7)</td>
<td>5 (23.8)</td>
<td>14 (70)</td>
</tr>
<tr>
<td>Age (yr; mean ± SD)</td>
<td>46.0 ± 13.6</td>
<td>46.1 ± 13.7</td>
<td>45.0 ± 13.2</td>
<td>46.4 ± 13.9</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>108 (85.7)</td>
<td>75 (88.2)</td>
<td>16 (76.2)</td>
<td>17 (85)</td>
</tr>
<tr>
<td>African-American</td>
<td>11 (8.7)</td>
<td>5 (5.9)</td>
<td>3 (14.3)</td>
<td>3 (15)</td>
</tr>
<tr>
<td>Asian</td>
<td>2 (1.6)</td>
<td>1 (1.2)</td>
<td>1 (4.8)</td>
<td>0</td>
</tr>
<tr>
<td>Hispanic</td>
<td>2 (1.6)</td>
<td>1 (1.2)</td>
<td>1 (4.8)</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>3 (2.4)</td>
<td>3 (3.5)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Positive History of Smoking</td>
<td>17 (13.5)</td>
<td>14 (16.5)</td>
<td>2 (9.5)</td>
<td>1 (5)</td>
</tr>
</tbody>
</table>
The subgroups of patients with CRSsNP, CRScNP, and polypoid CRS had similar profiles of initial medication use for antihistamine, antihistamine-decongestant, nasal ipratropium, cromolyn, azelastine, and decongestant, with the notable exception that there was more nasal steroid, leukotriene blocker, inhaled bronchodilator, and saline rinse use in both the polypoid and the polyp subgroups (p < 0.05 for each). There was no difference between groups for inferior turbinate appearance and response to decongestant evaluated as part of the physical exam. Patients with a history of sinus surgery had a similar profile of initial medication use as that without sinus surgery, with the exception that there was more saline rinse and leukotriene blocker use in those with prior surgery.

**Rhinoscopic Findings at Initial Visit**

The initial rhinoscopic examination documented the presence of mucus/purulence, edema, polypoid changes, and/or polyps in the sinus cavities (maxillary, MM/OMU, ethmoid, and superior meatus/SM) on enrollment. Approximately 33% of the patients had undergone previous sinus surgery. Approximately 30% had mucus and 27% had edema present on initial rhinoscopy. Polyps were found in 16.7% (CRScNP, n = 21) and polypoid mucosa was found in 15.9% (n = 20). The prevalence of polyps and/or polypoid mucosa in any sinus area was 32.6% (n = 41), and these features were bilateral in 85% of cases. In contrast, mucus/purulence was bilateral in only 50% of patients with this finding. The rhinoscopic examination was normal in 11.9% of patients.

**Comparison of CRSsNP, Polyoid CRS, and CRScNP by Symptom Presentation**

Comparison of the prevalence of symptoms in the CRSsNP, polypoid CRS, and CRScNP subgroups revealed considerable overlap. However, the symptom complex of facial pain/pressure/headache was more prevalent in CRSsNP (p = 0.01) compared with CRScNP. In contrast, nasal obstruction and hyposmia/anosmia were more prevalent in CRScNP (p = 0.025 and 0.01, respectively) compared with CRSsNP. The polypoid CRS group (n = 20) was intermediate, falling between CRSsNP and CRScNP in terms of major symptoms (Fig. 2). The mean number of major criteria was greater in the CRScNP than CRSsNP (3.43 versus 2.91 [Δ = 0.52]; p = 0.0075; CI, 0.14–0.90). The mean number of major criteria for polypoid CRS patients was intermediate at 3.1. No difference was found between CRSsNP and CRScNP or polypoid CRS in terms of the frequency of minor symptom criteria.

**Sinus CT Scan Severity Score at Initial Visit**

The severity score of the sinus CT at entry into the study was compared between patients with surgery versus patients with no prior surgery, clinical allergic rhinitis versus nonallergic rhinitis, and CRSsNP versus CRScNP versus polypoid CRS. Complete sinus CT data were obtained on 121 patients. No differences in sinus CT severity score were seen based on allergic status. A significantly greater amount of mucosal thickening and sinus opacification was found in CRScNP versus CRSsNP (p = 0.0001) patients and in CRS patients with prior surgery versus no surgery (p = 0.0015). The polypoid CRS group had an average sinus CT score of 9.9 ± 6.9, which was intermediate between CRSsNP (5.9 ± 5.6) and the CRScNP (15.9 ± 7.2; Fig. 3).

**Relationship between Prior Surgery and Rhinoscopic Appearance**

Of the study group, 42 patients had prior sinus surgery and 84 patients had no prior surgery. These subgroups were compared based on rhinoscopic appearance. Using univariate

![Figure 2](image-url)
analysis, a statistically significant relationship was found between having undergone prior sinus surgery and the presence of polyps in either the MM/OMU (p = 0.02) or the SM (p = 0.025). Likewise, a statistically significant relationship was found between having undergone prior sinus surgery and the presence of polypoid changes in either the MM/OMU or the SM (p = 0.01). In contrast, no relationship was found between having undergone prior sinus surgery and the presence of mucus/purulence in either the MM/OMU or the SM (p = 1.0 and p = 0.1, respectively) or edema in the MM/OMU (p = 1.0). However, a statistically significant relationship was found between having undergone prior sinus surgery and the presence of edema in the SM (p = 0.01).

Overall Comparison of CRSsNP versus Polyp/Polypoid Phenotype (CRScNP)

Based on our assumption that polypoid CRS may represent an early stage of CRScNP, we combined the polypoid and polyp subgroups in the subsequent analyses. Using univariate analysis, we looked for patient characteristics that would predict polyp/polypoid phenotype. After this, a stepwise multiple logistic regression analysis was performed to identify factors that had an independent association with this phenotype. As shown in Table 2, the univariate analysis found that gender, moderate to severe asthma, previous surgery, facial pain, nasal obstruction, anosmia, edema in the superior meatus, and the CT scan score were predictors of the polyp/polypoid phenotype. Each of these predictors was then introduced into the multivariate analysis. The results from this are summarized in Table 3 and indicate that previous surgery (p < 0.0001; odds ratio, 28.3), sinus CT scan score (p < 0.0001; odds ratio, 1.16 for each unit increase in the CT scan score), and male gender (p = 0.030; odds ratio, 3.92) were the only three variables with a significant independent association with the polyp/polypoid phenotype.

Relationship between Skin Test Reactivity and Rhinoscopic Appearance

Complete allergy skin testing data were available for the patients seen in the Allergy/Immunology Clinic (n = 47). After prick and intradermal skin testing, 33 patients were skin test positive and 14 were skin test negative. Using chi-square analysis (and Fischer’s exact test when n < 5), no statistically significant relationship was found between polyp, polypoid, or combined polyp/polypoid phenotype (in either MM/OMU or SM) and the results of skin testing. Likewise, no significant relationship was found between edema and allergic status based on skin testing; however, mucus/purulence was seen more commonly in skin test–positive patients (p = 0.05).

Prospective Data Collection over 1-Year Outcomes Study

For the 91 patients who submitted medication use data forms, antibiotic and oral steroid use was analyzed during the first 150 days of enrollment in the study. These data were analyzed in terms of days on medication as well as number of prescriptions given during the first 150 days. Overall, antibiotics were used for an average of 36.6 days with 1.9 prescriptions and oral steroids were used for 17.2 days with 1.55 prescriptions. The CRScNP patients had a higher use of antibiotics (61.8 days versus 31.2 days [Δ = 30.6]; p = 0.013; CI, 9.2–51.8) and antibiotic prescriptions (2.61 versus 1.72 [Δ = 0.89]; p = 0.0092; CI, 0.23–1.56) compared with the CRSsNP group. The CRScNP patients also had a higher use of oral steroids (32.1 days versus 9.7 days [Δ = 22.4]; p = 0.022; CI, 7.9–37.7) and oral steroid prescriptions (2.67 versus 0.96 [Δ = 1.71]; p = 0.00007; CI, 0.83–2.58) compared with the CRSsNP group. The polypoid group was very similar to the CRScNP group in terms of oral steroid use (32.7 ± 46.7 days) and oral steroid prescriptions (2.1 ± 1.9) but similar to the CRSsNP group in terms of antibiotic use (32.7 ± 29.6 days) and antibiotic prescriptions (1.6 ± 1.1).

DISCUSSION

The results of this study indicate that in comparison to patients with CRSsNP, patients with either CRScNP or polypoid CRS have an overlapping but distinguishable profile of symptoms (less facial pain/pressure/headaches and more
nasal obstruction and hyposmia/anosmia), a greater overall burden of CRS symptoms, a much greater likelihood of prior sinus surgery, more extensive mucosal disease on sinus CT scan, and greater use of medications. CRScNP and polypoid CRS patients reported a higher frequency of three of the four major criteria for CRS, viz., hyposmia/anosmia, nasal obstruction, and nasal purulence/discharge, at entry into the study. In contrast, patients with CRSsNP had a higher prevalence of nasal pain/pressure/headache.

On rhinoscopic examination, we found that polyp or polypoid changes were present bilaterally in ~85% of patients, and mucus/purulence was bilateral in only ~50% of cases. This suggests that the “polyp/polypoid” phenotype is reflective of a diffuse rather than a localized inflammatory process and also argues for inclusion of polypoid CRS under the heading of CRScNP. In contrast, mucus/purulence appears more likely to result from other localized inflammatory processes. Our study also revealed that patients with CRScNP or polypoid CRS were more likely to have had previous sinus surgery. However, CRSsNP, CRScNP, and polypoid CRS were not distinguished based on allergic status.

Recent studies suggest that CRSsNP and CRScNP are distinct pathological entities. Sinus tissues from CRScNP and CRSsNP patients have shown distinct patterns of inflammatory cells and cytokines. Higher concentrations of albumin and IL-5 and significantly increased numbers of eosinophils were found in CRSsNP. Meanwhile, a greater degree of glandular hyperplasia and hypertrophy with more tissue fibrosis was found in CRScNP. We are only aware of one previous study to examine “polypoid” CRS. In that study, polypoid turbinate tissue was found to have submucosal albumin accumulation and eosinophil infiltration, suggesting that this lesion is analogous to the earliest stage of a nasal polyp. The previous studies left unanswered the question of whether CRSsNP, CRScNP, and polypoid CRS could be dis-

Table 2  CRS study population characteristics*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total Population (n = 126)</th>
<th>Non-Polypoid (n = 85)</th>
<th>Polyp/Polypoid (n = 41)</th>
<th>p Value§</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male gender</td>
<td>52 (41.3)</td>
<td>30 (35.3)</td>
<td>22 (53.7)</td>
<td>0.050</td>
</tr>
<tr>
<td>Age (years)</td>
<td>46 ± 13.6</td>
<td>46.1 ± 13.7</td>
<td>45.7 ± 13.4</td>
<td>0.878</td>
</tr>
<tr>
<td>Race#</td>
<td></td>
<td>86.0%</td>
<td>88.0%</td>
<td>0.244</td>
</tr>
<tr>
<td>Smoking status</td>
<td>13.5%</td>
<td>16.5%</td>
<td>7.3%</td>
<td>0.159</td>
</tr>
<tr>
<td>Clinical Characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate/severe asthma</td>
<td>7.1%</td>
<td>3.5%</td>
<td>14.6%</td>
<td>0.023</td>
</tr>
<tr>
<td>Allergic rhinitis</td>
<td>49.2%</td>
<td>49.4%</td>
<td>48.8%</td>
<td>0.947</td>
</tr>
<tr>
<td>Immunotherapy</td>
<td>11.1%</td>
<td>9.4%</td>
<td>14.6%</td>
<td>0.382</td>
</tr>
<tr>
<td>Previous surgery</td>
<td>33.3%</td>
<td>14.1%</td>
<td>73.2%</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Presenting symptoms</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facial pain</td>
<td>91.3%</td>
<td>95.3%</td>
<td>82.9%</td>
<td>0.021</td>
</tr>
<tr>
<td>Nasal obstruction</td>
<td>48.4%</td>
<td>42.3%</td>
<td>61.0%</td>
<td>0.050</td>
</tr>
<tr>
<td>Nasal discharge</td>
<td>96.0%</td>
<td>94.1%</td>
<td>100.0%</td>
<td>0.173</td>
</tr>
<tr>
<td>Anosmia</td>
<td>71.4%</td>
<td>64.7%</td>
<td>85.4%</td>
<td>0.016</td>
</tr>
<tr>
<td>Objective measures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT scan score</td>
<td>7.9 ± 7.0</td>
<td>5.7 ± 5.5%</td>
<td>12.8 ± 7.5%</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Mucus in MM/OMU</td>
<td>15.4%</td>
<td>15.7%</td>
<td>15.0%</td>
<td>0.924</td>
</tr>
<tr>
<td>Edema in MM/OMU</td>
<td>18.7%</td>
<td>20.5%</td>
<td>15.0%</td>
<td>0.465</td>
</tr>
<tr>
<td>Mucus in SER</td>
<td>20.2%</td>
<td>16.5%</td>
<td>27.5%</td>
<td>0.156</td>
</tr>
<tr>
<td>Edema in SER</td>
<td>14.3%</td>
<td>10.1%</td>
<td>22.5%</td>
<td>0.070</td>
</tr>
</tbody>
</table>

*Dichotomous variables are shown as the percentage in each group. Continuous variables are shown as the mean ± SD. Variables that were subsequently considered as candidates for the multivariate analysis were those that achieved significant or nearly significant results in this table.

#Race indicates the percentage of each group that was white.

§The value of p is for the comparison of nonpolypoid (CRSsNP) vs polyp/polypoid CRS.

Table 3  Factors that have a significant independent association with the presence of polyps or polypoid mucosa

<table>
<thead>
<tr>
<th>Outcome Measure</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous surgery</td>
<td>28.3</td>
<td>7.5–106.7</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>CT scan score</td>
<td>1.16*</td>
<td>1.07–1.27</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Male gender</td>
<td>3.92</td>
<td>1.08–14.2</td>
<td>0.03</td>
</tr>
</tbody>
</table>

*The odds ratio for the CT scan score reflects the increased risk that is associated with each increase of 1 unit in the CT score.
tiquished by symptom profiles and radiographic appearance or perhaps also by allergic status or need for medications.

The results of this study suggest that patients with polypoid CRS have clinical features most similar to patients with CRScNP. Based on these results and the fact that polyp or polypoid disease usually is a diffuse process, we suggest that patients with bilateral polypoid mucosa be classified under the subgroup of CRScNP. The current CRS classification would classify such patients under CRSsNP, because it requires current or past evidence of bilateral nasal polyps visible in the MM to fulfill the definition of CRScNP.14 The polypoid CRS group represents an interesting subset of patients perhaps being in the earliest stage of nasal polyp formation. We feel that the findings in this study provide some rationale for classifying patients with bilateral polypoid CRS under the heading of CRScNP.

Allergic status, based on skin testing, was not associated with the presence of polyps or polypoid mucosa on rhinoscopic examination. It is clear that systemic signs of allergy are not required even in CRS patients with advanced mucosal eosinophilic inflammation.15 Nonetheless, the role of allergic mechanisms in the eosinophilic inflammation of CRS remains an area of ongoing investigation, and the possibility has been raised that local allergic mechanisms, such as local production of Staphylococcal superantigen-specific IgE or local accumulation of fungal-specific T lymphocytes, may contribute significantly to the inflammatory process. The results of our study neither support nor refute these theories, but confirm that systemic allergic phenotype is not a predictor of CRS mucosal pathology.

A significant relationship was found between prior sinus surgery and either polyps or polypoid mucosa but not the presence of mucus/purulence in the MM/OMU or SM. The association of polyp/polypoid phenotype and prior sinus surgery may reflect that patients with the polyp/polypoid phenotype are more likely to have undergone surgery. Our data collection forms did not allow us to determine whether this difference existed before sinus surgery or, alternatively, whether the surgery itself had something to do with development of this phenotype.

It has been reported previously that development of nasal polyps complicates the management of CRS. Evidence comes from studies assessing recurrence of disease after surgical5 or medical intervention.6 Specifically, Senior et al. found that patients with “advanced mucosal disease” were more likely to show persistence of mucosal disease after FESS, and these same patients were more likely to undergo revision surgery.16 Deal et al. similarly showed that the presence of nasal polyps had a significant negative impact on CRS surgical outcomes.17 In that study of 201 patients, CRScNP patients had more severe symptoms, higher SNOT-20 scores before surgery, less improvement after surgery and either polyps or polypoid mucosa but not the presence of mucus/purulence in the MM/OMU or SM. The association of polyp/polypoid phenotype and prior sinus surgery may reflect that patients with the polyp/polypoid phenotype are more likely to have undergone surgery. Our data collection forms did not allow us to determine whether this difference existed before sinus surgery or, alternatively, whether the surgery itself had something to do with development of this phenotype.

In evaluating antibiotic and oral steroid use, we found, first, that CRS patients used large amounts of these medications. On average for the patients followed at least 150 days, these amounted to 56.6 and 17.4 days of use, respectively, which extrapolates to antibiotic treatment for 2 weeks, a total of 6 times a year. Such use is not uncommon in CRS patients. Perhaps even more alarming is the small incremental gain afforded by antibiotic or oral steroid treatment in many cases. Our assessment of the improvement in SNOT-20 + 1 scores achieved over the 1-year study revealed an average level of change of −0.6 units, suggesting that, on average, patients continued to be symptomatic despite aggressive medical intervention.18 This merely affirms the dismal state of current treatment for CRS. Intra-nasal steroids have shown benefit for treatment of established nasal polyposis or in prevention of their recurrence in some, but certainly not all, studies. In fact, one recent study using intranasal fluticasone propionate for up to 1 year after FESS showed no benefit.19 Few other controlled trials of medical intervention for CRS have been published, and this lack of proven therapies undoubtedly contributes to the extensive use of antibiotics and oral steroids for this condition. We hope that this study will increase awareness for the overall burden of CRS in terms of symptoms, impact on quality of life, and use of medications.

REFERENCES


