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Impact of odontogenic chronic rhinosinusitis on general health-related quality of life

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Abstract

Chronic rhinosinusitis (CRS) may arise due to odontogenic etiologies. However, it is unknown whether odontogenic CRS has a differential impact on patients' quality of life (QOL) compared to standard, inflammatory (but non-odontogenic) CRS. The objective of this study was to determine whether there is a difference in the impact of sinonasal symptomatology on general health-related QOL in odontogenic CRS compared to non-odontogenic CRS. This was a retrospective review of 21 odontogenic CRS patients who visited our tertiary care center. The severity of sinonasal symptomatology and CRS-specific QOL detriment was measured using the 22-item Sinonasal Outcomes Test (SNOT-22) and general health-related QOL was measured using the health utility index from the 5-item EuroQol survey (EQ-5D HUV). Compared to non-odontogenic CRS, odontogenic CRS was not associated with a difference in SNOT-22 score [linear regression coefficient (β) = − 1.57, 95% CI − 12.47 to 9.32, p = 0.777] but was significantly associated with decreased EQ-5D HUV (β = − 0.10, 95% CI − 0.17 to − 0.03, p = 0.008). We also found that the magnitude of association (β) between SNOT-22 and EQ5D-HUV was greater for odontogenic CRS patients compared to non-odontogenic CRS patients (p = 0.045). Our findings suggest sinonasal symptoms may have a greater impact on general QOL in odontogenic CRS compared to non-odontogenic CRS. The reason for this remains unknown, but deserves further study.

Keywords Chronic rhinosinusitis · Odontogenic sinusitis · Non-odontogenic sinusitis · SNOT-22 · EQ-5D HUV · Quality of life

Introduction

Chronic rhinosinusitis (CRS) is a well-recognized disease in the field of otolaryngology, maxillofacial surgery and dentistry due to its myriad of causes [1]. CRS is an inflammatory disease of the sinonasal mucosa and affects 1–5% of the population. Aside from its detrimental effects on the patients' quality of life (QOL) through chronic sinonasal symptoms, CRS exacerbations as well as exacerbation of comorbid diseases, CRS is associated with a lifetime of significant medical and surgical healthcare expenditures [2–4]. There are many mechanisms for development and persistence of CRS including allergy, infection, immune dysfunction and poor mucociliary clearance or it may have odontogenic etiology. However, because odontogenic sources are not the main cause of CRS, the significance of odontogenic CRS may be overlooked [5–10].

Historically, approximately 10–12% of the patients presenting with symptoms of chronic maxillary sinusitis are

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diagnosed with an odontogenic origin [11]. The most likely etiology of odontogenic sinusitis is dentoalveolar surgery or odontogenic infection (dental abscess) with perforation of the Schneiderian membrane, and secondary maxillary sinus infection which progresses if untreated first to sinusitis and then to odontogenic CRS [1, 12–14]. However, odontogenic CRS is often curable by addressing the odontogenic source and establishing drainage of the paranasal sinuses [15].

In previous studies we have shown that the decreased QOL experienced by CRS patients is associated with chronic sinonasal symptomatology, the frequency of acute CRS exacerbation as well as the exacerbation of comorbid pulmonary disease [2–4]. However, the severity of sinonasal symptomatology has the greatest impact on general health-related QOL in CRS. As a result, assessment of sinonasal symptom severity is the most common way of clinically evaluating CRS patients. In order to understand the impact of odontogenic CRS on afflicted patients, it is therefore most helpful to understand the how this disease affects patients' sinonasal symptom severity as well as general health-related QOL compared to non-odontogenic CRS. In this study, we hypothesized that the severity of sinonasal symptoms and the general health-related QOL in odontogenic CRS patients would be different compared to non-odontogenic CRS patients.

Materials and methods

Study participants

This study was approved by our institution's Human Studies Committee. Adult patients of age 18 years or older seen in our clinics between February 1, 2016 and February 1, 2017 who were diagnosed with CRS based on consensus guideline established criteria were screened and identified retrospectively from the medical record [16]. All study participants provided informed consent for inclusion and patient anonymity was preserved. In order to have a homogeneous CRS cohort and avoid any sinonasal diseases with extra-rhinologic features, our exclusion criteria included comorbid diagnoses of vasculitis, cystic fibrosis, sarcoidosis and immunodeficiency. In order to avoid confounding results due to treatment, any patient who had underwent sinonasal surgery in the last 6 months was also excluded.

Determination of odontogenic vs. non-odontogenic CRS

The determination of an odontogenic etiology for patients' CRS was made based on history and radiographic findings as described previously [17–19]. At present, there are no consensus diagnostic criteria to differentiate odontogenic from non-odontogenic CRS. However, odontogenic CRS is clearly a distinct clinical entity and it is identified through clinical characteristics including history and radiographic findings as described in the literature and recommended in clinical consensus statements [17–19]. For our study and in our clinical practice, we followed these recommendation specifically identifying all patients who had evidence of at least chronic maxillary rhinosinusitis ipsilateral to a dehiscent peri-apical abscess, oroantral fistula, recent maxillary dental procedure or other source of seeding of the maxillary sinus by oral bacterial flora as having odontogenic CRS.

Study design and data collection

This was a retrospective review of 21 odontogenic CRS patients who visited our center between February 1, 2016 and February 1, 2017. All of these 21 odontogenic CRS patients received their initial diagnosis from us and therefore none had undergone surgical intervention for their sinus disease. For comparison to the odontogenic CRS patients, 200 uncomplicated non-odontogenic CRS patients (who had no evidence of any dental process that could be causing or contributing to their sinus disease) were randomly selected from during the same study period. The age, gender, CRS-related intranasal corticosteroid use, comorbidities (including aeroallergen hypersensitivity based on skin or serological allergy testing, asthma, diabetes, heart disease, and cancer) and smoking history of all participants were recorded. Any participant who was a current or former tobacco smoker was considered a smoker for this study. The severity of sinonasal symptomatology and CRS-specific QOL detriment was measured using the 22-item Sinonasal Outcomes Test (SNOT-22) [20] and general health-related QOL was measured using the health utility index from the 5-item EuroQol QOL survey (EQ-5D HUV) [21].

Statistical analysis

All analyses were performed with the statistical software package R [22]. In addition to standard descriptive statistics, the associations of an odontogenic source for patients' CRS (as independent variable) with SNOT-22 score of EQ-5D HUV (as dependent variables) were checked using linear regression. Multivariable regression models—controlling for age, gender, smoking history, intranasal corticosteroid use, SNOT-22 score as well as comorbid diagnoses of aeroallergen hypersensitivity, asthma, diabetes, heart disease, and cancer—were also used. Linear regression between SNOT-22 (as independent variable) and EQ-5D HUV (as dependent variable) was also performed.

Results

Patient characteristics

A total of 21 patients (52.4% males and 47.6% females; mean [SD] age, 55.5 [16.7] years) with odontogenic CRS and a total of 200 patients (50.8% males and 49.2% females; mean [SD] age, 52.9 [15.8] years) with non-odontogenic CRS were identified, and their characteristics are summarized in Table 1. Of these study participants, 19.0% of odontogenic and 23.5% of non-odontogenic patients were current or former cigarette smokers. Of the odontogenic CRS patients 9.5% had at least one aeroallergen hypersensitivity, 9.5% described asthma, 14.3% had diabetes, 0.0% heart disease/history of myocardial infarction and 9.5% history of cancer. Of the non-odontogenic CRS patients 48.5% had at least 1 aeroallergen hypersensitivity, 29.5% described asthma, 6.5% had diabetes, 2.5% heart disease/history of myocardial infarction and 5.0% history of cancer. Of all odontogenic CRS study participants, 28.6% used intranasal corticosteroid medication for CRS management and 49.0% of the non-odontogenic CRS patients used intranasal corticosteroids. Of all characteristics, only the prevalence of aeroallergen hypersensitivity was significantly different between the odontogenic and non-odontogenic CRS group.

We next assessed the SNOT-22 score and EQ-5D HUV of odontogenic and non-odontogenic CRS patients (Fig. 1). The mean SNOT-22 score for odontogenic CRS was 32.7 (SD = 20.6) compared to 34.2 (SD = 22.8) for non-odontogenic CRS. The mean EQ-5D HUV was 0.75 (SD = 0.19) for odontogenic CRS compared to 0.85 (SD = 0.15) for non-odontogenic CRS. Odontogenic CRS was not associated with SNOT-22 score (linear regression coefficient [β] = −1.57, 95% CI −12.47 to 9.32, $p = 0.777$), but an odontogenic source for CRS was significantly associated with decreased EQ-5D HUV ($\beta = -0.10$, 95% CI −0.17 to −0.03, $p = 0.008$). After controlling for age, gender, smoking history, intranasal corticosteroid use, SNOT-22 score as well as comorbid diagnoses of aeroallergen hypersensitivity, asthma, diabetes, heart disease, and cancer—all of which may affect general health-related QOL, odontogenic CRS was still associated with decreased EQ-5D HUV ($\beta = -0.07$, −0.15 to −0.01, $p = 0.046$).

We next hypothesized that this may be due to a differential impact of sinonasal symptomatology on patients' general health-related QOL in odontogenic CRS compared to non-odontogenic. In each of these patient cohorts we therefore checked the association between SNOT-22 score and EQ-5D HUV. We found a statistically significant association between EQ-5D HUV (as dependent variable) and SNOT-22 (as independent variable) in both the odontogenic CRS ($\beta = -0.006$, 95% CI −0.009 to −0.003, $p = 0.001$) and the non-odontogenic CRS ($\beta = -0.003$, 95% CI −0.004 to −0.002, $p < 0.001$). However, the magnitude of this association (reflected by the linear regression coefficient, β) was significantly greater for the odontogenic CRS cohort compared to the non-odontogenic CRS cohort ($p = 0.045$). This result indicates that for every incremental increase in SNOT-22, there was a greater incremental decrease in general health-related QOL for the patients with odontogenic CRS patients compared to those with non-odontogenic CRS (Fig. 2).

Table 1 Clinical and demographic characteristics of CRS patients

	Odontogenic ($N = 21$)	Non-odontogenic ($N = 200$)
Demographics		
Age, mean in years, (SD)	55.5 (16.7)	52.9 (15.8)
Gender		
Male	52.4%	50.8%
Female	47.6%	49.2%
Smoking	19.0%	23.5%
Comorbidities		
Aeroallergen hypersensitivity	9.5%	48.5%
Asthma	9.5%	29.5%
Diabetes	14.3%	6.5%
Heart disease/history of myocardial infarction	0.0%	2.5%
History of cancer	9.5%	5.0%
CRS characteristics		
Intranasal steroid use	28.6%	49.0%
SNOT-22 score, mean (SD)	32.7 (20.6)	34.2 (22.8)
EQ-5D Health Utility Value, mean (SD)	0.75 (0.19)	0.85 (0.15)

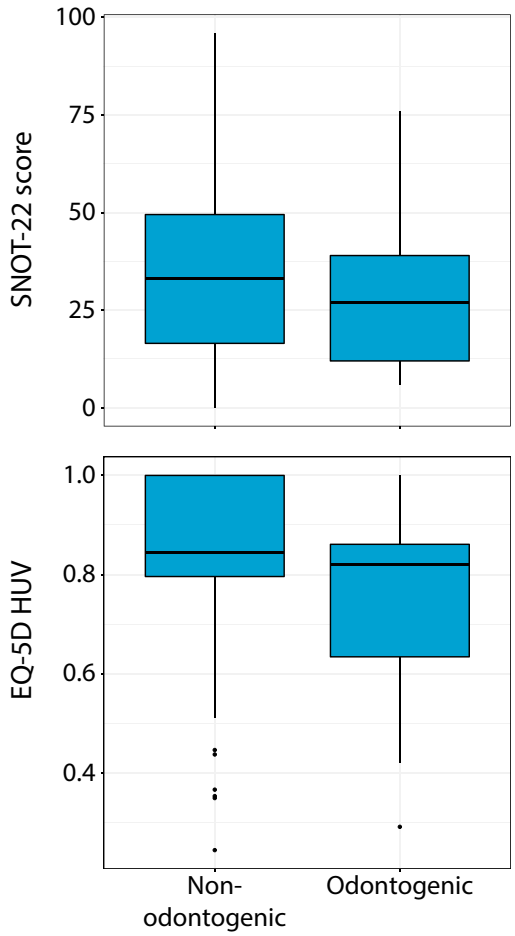

Fig. 1 Boxplots showing the **a** SNOT-22 scores and **b** EQ-5D health utility value (HUV) of patients with odontogenic and non-odontogenic CRS. The box extends from the 1st quartile to the 3rd quartile and the median is depicted by a horizontal line. Whiskers extend to 1.5*(interquartile range) beyond the 3rd quartile

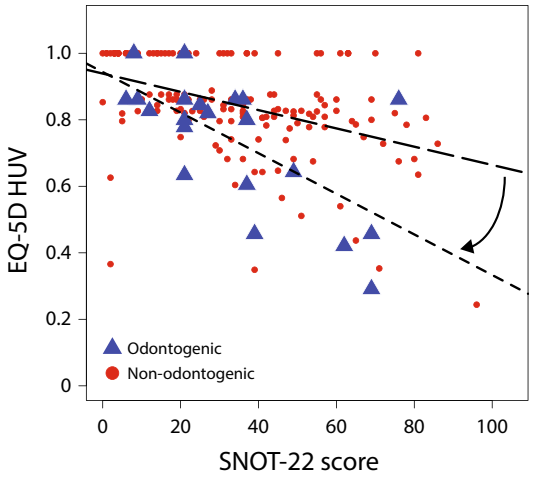

Fig. 2 Scatterplot of EQ-5D HUV vs. SNOT-22 score. Non-odontogenic CRS patients are represented by red circles, while odontogenic CRS patients are represented by blue triangles. The lines of best fit for non-odontogenic CRS patients (large dashes) and odontogenic CRS patients (small dashes) are super-imposed. The arrow indicates the shift in the EQ-5D HUV vs. SNOT-22 relationship that we find for non-odontogenic vs. odontogenic CRS

Discussion

CRS of odontogenic origin is a well-recognized condition, but it is underappreciated [23, 24]. Odontogenic CRS may have a significant impact on patients through chronic symptomatology as well as infectious orbital—or even intracranial—complications. Odontogenic CRS often presents as a recalcitrant rhinosinusitis, but no single symptom from the various sinonasal complaints has been shown to be characteristic for odontogenic sinusitis. Odontogenic CRS manifests particularly in the setting of unilateral disease and is most often accompanied with dental pain, ipsilateral cheek pain, rhinorrhea and foul smell or taste [23, 24]. Previous studies have shown that nasal obstruction and facial pain are the most bothersome symptoms for the patients with odontogenic CRS [23, 24].

However, the degree to which odontogenic CRS impacts patients with respect to the severity of sinonasal symptomatology and general health-related QOL remains poorly characterized. In this study, we sought to characterize the association between the severity of sinonasal symptomatology (reflected by SNOT-22) and general health-related QOL (reflected by EQ-5D HUV) in CRS of odontogenic vs. non-odontogenic etiologies. We found that although odontogenic CRS was not associated with more severe CRS symptomatology (i.e., higher SNOT-22 score), odontogenic CRS was associated with a significantly greater general health-related QOL detriment. We further found that this was likely due to chronic sinonasal symptomatology having a greater impact on general health-related QOL in odontogenic CRS compared to non-odontogenic CRS.

Previous work has shown that a general health-related QOL detriment is one of the most significant consequences of CRS. This QOL detriment in CRS is largely driven by the burden of sinonasal symptomatology. Therefore the relationship of chronic sinonasal symptomatology with general health-related QOL is critical to understanding how CRS impacts patients. In our study, we found that the overall severity of CRS symptoms was similar in odontogenic CRS patients compared to non-odontogenic CRS patients. By contrast, the odontogenic CRS patients had a significantly greater decrease in general health-related QOL. It is of interest to understand why this might be the case. Our analyses controlled for many comorbidities that are known to drive down general health-related QOL and so these results may be viewed as independent of comorbidities. One hypothesis is that the impact of chronic sinonasal symptoms on odontogenic

CRS is greater than in patients with non-odontogenic CRS. We found that although the severity of CRS symptoms was significantly associated with decreased general health-related QOL in both CRS cohorts, the severity of CRS symptoms was associated with a significantly greater decrease in general health-related QOL in the odontogenic CRS cohort compared to the non-odontogenic CRS cohort. This finding lends credence to the hypothesis that CRS symptoms may have a greater impact on QOL in patients with odontogenic CRS. It remains unclear, however, why this might be the case. One possibility is that odontogenic CRS patients are usually free of sinus disease until suddenly struck by the disease while non-odontogenic CRS patients frequently have a long history of sinus-related problems and therefore may be more accustomed to chronic sinonasal symptomatology. Our results also suggest the possibility that early diagnostics and intervention in odontogenic CRS patients may help to preserve QOL as proper treatment of the primary odontogenic pathology will resolve the CRS symptoms [15, 25].

This study should be interpreted in the context of its limitations. The primary limitation of this study is its retrospective and cross-sectional design, which are impacted our ability to cull data from the medical record. The rating of CRS symptom severity and general health-related QOL was done through subjective—albeit validated—questionnaires, and not objective metrics of CRS severity, such endoscopy scores or sinus CT scan findings. However, patient-reported outcome measures, including those reflected on subjective questionnaires are the standard in evaluation of CRS while objective measures of disease severity have been shown to be unreliably correlated with how patients feel. Moreover, in understanding the impact of a disease, in particular one such as CRS where the primary impact is on QOL, it is most important to understand how the disease affects patients subjectively. In fact, the exact nature of the relationship between CRS disease manifestations, for example symptomatology, and general health-related QOL remains an active area of investigation. We used linear regression models in this study to estimate the impact of incremental changes in CRS symptom burden on general health-related QOL, which is consistent with the methodology of many prior studies that have examined this relationship [26–28]. However, it remains to be seen if this relationship between CRS symptom burden and general health-related QOL is strictly linear in nature or perhaps differentially linear for various subsets of CRS patients. For now, using linear regression models in conjunction with simple visual inspection of data, suggests to us that incremental changes in CRS symptom burden are associated with larger changes in general health-related QOL in patients with odontogenic CRS compared to non-odontogenic CRS.

Conclusion

Odontogenic CRS is associated with a significant general health-related QOL detriment that is comparable to that previously described for severe chronic diseases such as heart disease, diabetes, and COPD. Moreover, odontogenic CRS is associated with a greater general health-related QOL detriment compared to non-odontogenic CRS. This may be due to a significantly greater impact of chronic sinonasal symptomatology on general health-related QOL in odontogenic CRS patients compared to non-odontogenic CRS patients. Early recognition and intervention may therefore serve to prevent a great QOL impact by odontogenic CRS.

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Compliance with ethical standards

Conflict of interest The authors declare that there are no conflicts of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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