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Review Article

The Sinus and Nasal Quality of Life Survey (SN-5) in the Management of Pediatric Chronic Rhinosinusitis: A systematic review and meta-analysis

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ABSTRACT

Objectives: Pediatric chronic rhinosinusitis (CRS) is a prevalent condition with quality of life (QoL) impacts that are seldom reported in the literature. We aimed to conduct a systematic review and meta-analysis on studies using the Sinus and Nasal Quality of Life Survey (SN-5), the only validated symptom questionnaire in pediatric CRS.

Methods: A literature search was conducted to identify studies that used the SN-5 to measure QoL before and after medical or surgical interventions for pediatric CRS. Comparison of means and standard deviations was performed between pre- and post-intervention SN-5 scores.

Results: A total of 10 studies, consisting of 13 separate treatment arms of either medical therapy, adenoidectomy, balloon catheter sinuplasty (BCS), or functional endoscopic sinus surgery (FESS) were identified. The vast majority (92.3%) of the treatment arms demonstrated minimal clinically important differences between baseline and post-intervention SN-5 scores. Rates of treatment success and minimal clinically important difference among all treatment arms ranged from 43.2% to 94.0%. Comparison of means showed an improvement in SN-5 score of 1.97 [95% CI, 1.18 to 2.76; $p < 0.00001$] for BCS, 1.83 [95% CI, 1.47 to 2.19; $p < 0.00001$] for FESS, and 1.15 [95% CI, 0.36 to 2.66; $p = 0.13$) for medical treatment.

Conclusion: There is a paucity of literature on QoL outcomes in pediatric CRS. More studies using the SN-5, particularly those controlling for baseline patient characteristics, are necessary to fully elucidate the impact of various interventions on QoL in pediatric CRS.

1. Introduction

Chronic rhinosinusitis (CRS) is a prevalent disease that results in substantial resource utilization. According to the National Health Interview Survey, CRS affects 63.9 per 1000 persons under 18 years of age [1]. In the year of 1996 alone, rhinosinusitis was estimated to account for $5.8 billion in health care expenditures, with 30.6% of this expenditure spent on children 12 years or younger [2]. Cardinal symptoms of CRS include nasal congestion, purulent drainage, and facial pain; however, children may also present with persistent daytime cough. In addition to nasal symptoms, pediatric CRS often causes significant impact on sinonasal quality of life (QoL), and an important goal of treatment is to improve QoL for children with CRS. Medical treatment of CRS includes saline washes, topical/systemic glucocorticoids, or antibiotics. Surgical interventions such as adenoidectomy, balloon catheter sinuplasty (BCS), and functional endoscopic sinus surgery (FESS) are reserved for cases in which medical treatment is ineffective. According to the European Position Paper on Rhinosinusitis and Nasal Polyps 2012, the surgical approach to pediatric CRS should begin with adenoidectomy and sinus irrigation, followed by FESS [3].

The ability of QoL questionnaires to measure subjective symptoms over periods of time can assist in determining the efficacy of a certain intervention and whether or not a different treatment is warranted. The Sinus and Nasal Quality of Life Survey (SN-5) is the only validated symptom questionnaire for children ages 2–12 and is completed by parents to evaluate the QoL of their children with CRS. It includes five QoL domains, each scored on a scale from 1 to 7: sinus infection, nasal obstruction, allergy symptoms, emotional distress, and activity limitations, along with an assessment of global QoL that is scored on a 10-point visual analog scale. The SN-5 has been shown to have good test-retest reliability, construct validity, and responsiveness [4].

To our knowledge, there has not been a study that has

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comprehensively reviewed the impact of CRS treatments on QoL in the general pediatric population. The objective of this study is to explore the degree to which common interventions for pediatric CRS impact overall and domain-specific SN-5 scores. Secondary goals include understanding effect size for various treatments and identifying weaknesses and gaps in available evidence.

2. Materials and methods

2.1. Literature search

A comprehensive literature search of Scopus and PubMed was performed on March 7th, 2018 using the search terms: (chronic rhinosinusitis OR chronic sinusitis) AND (Sinus and Nasal Quality of Life Survey OR SN-5) and "(chronic rhinosinusitis OR chronic sinusitis) AND ("Sinus and Nasal Quality of Life Survey" OR SN-5)" respectively. Studies of interest were those that evaluated the impact of medical or surgical treatments on sinus-specific QOL in pediatric patients with CRS. Inclusion criteria for systematic review included pediatric subjects, use of one or multiple interventions to treat CRS, and use of the SN-5 to measure CRS outcomes. Inclusion criteria for meta-analysis included availability of complete follow-up data in addition to eligibility for systematic review. Exclusion criteria included use of outcome measurements unrelated to the SN-5, review articles, patients with cystic fibrosis, and lack of intervention-specific data. In the case of overlapping enrollment between two studies at the same institution, the study with the longer-term follow-up was used.

2.2. Data extraction

Two independent reviewers extracted data from all studies that met inclusion and exclusion criteria. Diagnostic criteria, patient demographics, and comorbidities were recorded for each study. The pre-treatment (baseline) and post-treatment overall and individual domain SN-5 scores, including means and standard deviations, were recorded whenever available. For the post-treatment SN-5 score, we used the longest duration of follow-up available in each particular study. In addition, data regarding the proportion of patients who improved, stayed the same, or worsened was recorded [4]. Any remaining study with missing follow-up data was excluded from data analysis but still included for purposes of the systematic review. Treatment was defined as a success if the patient experienced mild (SN-5 improvement from -0.50 to -0.99), moderate (SN-5 improvement from -1.00 to -1.49) or marked (SN-5 improvement of at least -1.50) improvement [4]. Minimally important difference has been demonstrated to be approximately half a standard deviation at baseline for HRQoL instruments [5]. As seen in Table 2, for most studies the SD is around 1.0 or less; thus, the minimal clinically important difference (MCID) for SN-5 is approximately 0.5, which is the same as the cutoff defined for treatment success. Data for proportions of patients who improved, stayed the same, or worsened, whenever available, are detailed in Table 3 [4]. Treatment was defined as a failure if the SN-5 score stayed the same (change of 0 to -0.49) or worsened (increase of at least 0.01) [4,6–8]. Level of evidence for each selected article was evaluated with the Oxford Center for Evidence-Based Medicine Levels of Evidence [9].

2.3. Meta-analysis

The meta-analysis utilized pre-treatment (baseline) to post-treatment measures, with all patients serving as their own controls. Meta-analysis of selected studies with a continuous measure (comparison of means and standard deviations between pre-treatment and post-treatment groups) was performed with Cochrane Review Manager (RevMan) version 5.3 (Nordic Cochrane Center, Cochrane Collaboration, 2011, Copenhagen, Denmark). Both the fixed effects model and the random effects model were used. Under the fixed effects model, the assumption is that all studies come from a common population, and that the effect size (standardized mean difference) is not significantly different among the different studies; this assumption is tested by the "heterogeneity test." If this test yielded a low probability value ($p < 0.05$), then the fixed effects model may be invalid. In this case, the random effects model, in which both the random variation within the studies and the variation between the different studies are incorporated, may be more appropriate. Under the random effects model, the true effects in the studies are assumed to vary between studies, and the summary effect is the weighted average of the effects reported in the various studies [10]. The random effects model provides a more conservative estimate (i.e., with a wider confidence interval [CI]), but the results from the two models usually agree when there is no heterogeneity. When heterogeneity was present, the random effects model was preferred. Additionally, the Sterne and Egger tests were performed to further assess risk of publication bias [11,12]. In this study, the null hypothesis was that there was no difference between pre-treatment and post-treatment with respect to medical treatment, adenoidectomy, BCS, and FESS. Data are presented as mean ± SD (95% CI) in this text and as mean difference (MD) in the figure. The total MD with 95% CI is given for both the fixed effects model and the random effects model. If the value 0 is not inside the 95% CI, then the MD is statistically significant at the 5% level ($p < 0.05$).

3. Results

A total of 281 articles were identified for review using our search strategy. Overall, 10 studies were included and are summarized in Table 1. In total, there were seven prospective case series, two prospective cohort studies, and one prospective case-control study included. All but one study, which was of Level 2 evidence, included in our systematic review were of Level 4 evidence. There were a total of 409 patients enrolled at baseline among all studies. Of those 409 patients, 376 completed follow-up. Studies were categorized into four groups: medical management, adenoidectomy, BCS, and FESS. Overall, medical management was studied in three articles, adenoidectomy was studied in two articles, FESS was studied in two articles, and BCS was studied in five articles. Data for overall and individual domain SN-5 scores, whenever available, are detailed in Table 2. Sterne and Egger tests ($P < .00001$) suggested a relationship between the sample size of these studies and their effect sizes, indicating a high likelihood of publication bias. This data was significantly heterogeneous ($I^2 = 93\%$, $P < .00001$). Thus, meta-analysis of these studies was performed with a random effects model.

3.1. Medical management

Three articles, forming a total of four treatment arms, studied the effect of medical treatment on SN-5 scores. The percentage of patients with complete follow-up data in the medical treatment arms ranged from 85% to 100%. Treatments included nasal saline lavage, gentamicin lavage, and oral antibiotics combined with topical steroids and saline [13–15].

Lin et al. conducted a case series on 10 patients who were unresponsive to prior medical treatment and received daily nasal saline lavage for one month. At baseline, the mean overall SN-5 score was 4.3 (0.8). At a mean of 10.4 months post-intervention, the mean overall SN-5 score significantly improved to 2.3 (0.7) ($p = 0.0002$). In addition, 90% of patients achieved treatment success (Table 3) [13].

Wei et al. compared two groups of patients both receiving medical treatments as part of a prospective, randomized, double-blinded cohort study. One cohort of 19 patients received daily intranasal saline irrigation, while the other cohort of 21 patients received topical gentamicin in addition to daily intranasal saline irrigation. Both cohorts were treated for six weeks each and evaluated at 3 and 6 weeks. A total of six patients did not complete follow-up, but it is unclear how many of these