The impact of sinus surgery on sleep outcomes

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Background: **Functional endoscopic sinus surgery (FESS) is standard for patients who fail medical management of chronic sinusitis (CRS). The beneficial impact of surgery on CRS is well known. However, patients often note that their sleep is improved after FESS even without simultaneous correction of nasal obstruction. Sleep outcomes after FESS are significantly understudied. Hence in the current study we look to characterize patient sleep quality following sinus surgery.**

Methods: **Data was gathered from 2 sites (Western University [Canada] and the Asia Sleep Center [Singapore]). Patients meeting diagnostic criteria for CRS without nasal polyposis (CRSsNP) were included. Cases with polyposis and those who needed a septoplasty were excluded so as to purely analyze the impact of the sinus surgery on sleep. Sleep outcomes recorded at baseline just prior to surgery and 6 months after surgery were the Epworth Sleepiness Scale (EpSS) and the Pittsburgh Sleep Quality Index (PSQI). We also recorded 22-item Sino-Nasal Outcome Test (SNOT-22) scores and Nasal Obstruction Symptom Evaluation (NOSE) scores. Comparisons were made with paired *t* tests.**

Results: **Fifty-three patients met inclusion/exclusion criteria. Sleep outcomes showed a clinically and statistically significant improvement (EpSS before FESS = 14.7 ± 3.1, EpSS after FESS = 9.1 ± 1.1, $p < 0.01$; PSQI before FESS = 10.9 ± 2.8, PSQI after FESS = 5.3 ± 2.2, $p < 0.01$). CRS-specific outcomes were improved as well. Nasal obstruction scores did not change significantly.**

Conclusion: **FESS improved sleep outcomes for the patients in our study. This was independent of correction of nasal obstruction. Sinus surgery for CRSsNP has a beneficial impact on sleep; this novel information can be used during patient counseling and for justification to third-party payers.** © 2015 ARS-AAOA, LLC.

Key Words:
chronic rhinosinusitis; sleep apnea; snoring; somnolence; endoscopic sinus surgery; Epworth Sleepiness Scale; Pittsburgh Sleep Quality Index

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Chronic rhinosinusitis (CRS) is common disease often quoted as afflicting up to 5% of the population, and is known to affect many facets of quality of life (QOL).[1] Recent evidence has shown that the level of debilitation suffered by individuals with CRS can in fact eclipse that of common chronic disorders such as congestive heart failure, back pain, and sciatica, as well as others. The effect of CRS on sleep is also beginning to be illuminated.[2,3] Sleep dysfunction, and its daytime corollary, fatigue, are part of the diagnostic criteria of the disease in both the Canadian and American CRS management guidelines.[1] CRS is known to adversely affect sleep, with several recent publications consistently showing that CRS causes a level of sleep dysfunction that could be considered pathological in up to 75% of patients.[4,5] Once sleep is affected, the morbid effect of CRS can become even harsher, as disturbed sleep has health consequences far beyond that of the disease-specific effects of CRS.

CRS patients suffering with nasal polyposis (CRSwNP) will logically have some degree at least of nasal obstruction and congestion. Functional endoscopic sinus surgery (FESS) will clearly improve that situation after the polyps are cleared out, and once the nose is open, sleep quality often improves.[6] What is unclear, however, is what the effect of FESS is on the subpopulation of CRS patients without nasal polyposis (CRSsNP) because nasal obstruction

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is less of a problem in these patients. Considering that in some studies evidence exists that CRSsNP is the more common phenotype of CRS, the question has epidemiological importance. The purpose of our study was to investigate the effect of FESS on sleep outcomes specifically in patients with CRSsNP.

Patients and methods

The research ethics board at Western University (Ontario, Canada) granted approval for this project (HSREB 105397). This study represents data gathered from 2 tertiary care academic surgical centers, those being Western University and the Asia Sleep Center (Singapore). At Western University, a single surgeon (B.W.R.) with subspecialty training in sinus surgery performed FESS for CRSsNP between January 1, 2013, and December 31, 2013, and at the Asia Sleep Center a single surgeon (K.P.P.) performed all FESS procedures over the same date range. Surgery was performed in cases where appropriate medical therapy had been attempted and failed including oral, broad spectrum, or culture-directed antibiotics (minimum 2-week duration) and topical nasal corticosteroid sprays (minimum 2-month duration) or topical antibiotic rinses. At intake all patients included in this study had an initial consultation including full head and neck exam, graded endoscopy, and computed tomography (CT) scan of the paranasal sinuses.

Inclusion criteria were as follows: (1) bilateral CRSsNP where cases met American Academy of Otolaryngology diagnostic criteria for CRSsNP and (2) subjective sleepiness as measured by a preoperative Epworth Sleepiness Scale (EpSS) score of a minimum of 10. Exclusion criteria were (1) cases of CRSwNP (any grade of polyposis), (2) nasal obstruction due to septal deviation, nasal valve collapse, or turbinate hypertrophy (so as to abrogate the effect of obstruction on sleep), (3) patients with a diagnosed sleep disorder (eg, apnea, insomnia, narcolepsy) as determined by polysomnography, (4) shift-workers (who are known to have problematic sleep), (5) known psychiatric disorder affecting sleep (eg, depression), and (6) patients otherwise unfit or inappropriate for elective surgery as deemed by the site surgeon. With regard to the issue of a diagnosed sleep disorder, those who had a negative polysomnogram prior to being involved in the current study were not retested. Those who had never been previously tested underwent screening with a Medibyte ambulatory sleep test system (Braebon, Kanata, Canada) from the Canadian site or a WatchPAT study (Itamar, Israel) from the Singapore site. If the screening tests were negative, this permitted their inclusion in the study. Positive screens were excluded and then offered therapy as appropriate.

All patients received standard surgical consent for FESS and underwent surgery. The precise nature of surgery was performed as deemed necessary by the site surgeon, but at a minimum included bilateral endoscopic ethmoidectomy and antrostomy. Frontal and sphenoid work were performed as indicated intraoperatively or based on CT findings. Patients who unexpectedly required a septoplasty or polypectomy intraoperatively were excluded from further data abstraction. All patients received standard perioperative care; however, systemic steroids were not used.

Sleep-specific outcome measures studied included the EpSS[7] and the Pittsburgh Sleep Quality Index (PSQI).[8] The EpSS is an extensively studied and well-validated marker for daytime sleepiness, and represents one of the most common metrics of pathological somnolence in general. The EpSS is scored from 0 to 24, with scores over 11 indicating abnormal sleepiness and 18 or over being deemed pathological. The PSQI is a validated and well-studied 19-item self-report measure of sleep quality and duration. This scale is scored from 0 to 21, where higher PSQI scores indicate greater sleep disturbance, with 5 being the cutoff for normal vs abnormal sleep quality.

We also studied disease-specific scales so as to maintain internal quality measures of the surgery. Patients completed the 22-item Sino-Nasal Outcome Test (SNOT-22) and the Nasal Obstruction Symptom Evaluation (NOSE) scale. SNOT-22 is an extensively used measure to study treatment outcomes applicable to CRS conditions both with and without polyposis, and is scored from 0 to 110 with higher scores representing worsening levels of disease-specific QOL. The NOSE scale is a validated and reliable tool measuring patients' self-assessment of obstructive nasal symptoms, and is scored from 0 to 25, with higher scores representing worse levels of nasal obstruction.

All outcomes were recorded at baseline (within 1 month before surgery) and then at the 6-month postoperative mark. We also recorded routine demographic data and surgical details including complications if any. All data were analyzed via SPSS 18.0 software (Chicago, Illinois, USA). Descriptive metrics were tabulated for demographic variables and outcome tool responses. We assessed for data normality using Kolmogorov-Smirnov analysis. Comparisons of means and standard deviation (SD) were made using paired Student *t* tests and were performed for all 4 outcome measures. Pearson's correlation coefficient was used to assess the relationship between the sleep-specific and CRS-specific outcomes. An a priori significance level of <0.05 was assigned for meaningful differences in the data. A formal sample-size calculation was not performed; instead, we collected data on consecutive patients with CRSsNP for 1 year, and then excluded those not meeting study criteria.

Results

A total of 74 consecutive patients were abstracted initially. Seventeen of these were deemed intraoperatively to need either septoplasty or polypectomy and were subsequently excluded, leaving 57 who met all inclusion/exclusion criteria and underwent surgery. Four of these patients were lost to follow-up after surgery, which resulted in a final population of 53 for data analysis. In the final group of 53 patients, 41 came from Canada and 12 from Singa-

TABLE 1. Demographics of the study population*

Age (years), mean	52.3
Male:female (n)	35:18
Prior sinus surgery	23 (43.4)
Current smoker	12 (22.6)
Underwent sphenoid surgery	24 (45.3)
Underwent frontal surgery	21 (39.6)

[a]Values are n (%) unless otherwise indicated.

pore. Within the final study population there was 1 surgical complication: a single postoperative hemorrhage controlled with nasal cautery and use of topical hemostatic agents. Demographic details of the population are shown in Table 1.

Disease-specific measures were reported. SNOT-22 scores had a mean of 57.1 ± 9.4 preoperatively and dropped to 12.3 ± 6.5 at 6 months after surgery ($p < 0.01$), indicating successful disease treatment via surgery. NOSE scores were unchanged over the course of data collection, ranging from a preoperative score of 7.5 ± 1.4 to a postoperative score of 6.8 ± 2.1 ($p = 0.13$), indicating that nasal obstruction was a minimal problem for patients both before and after the study, and was not meaningfully affected by the surgery.

Sleep-specific outcomes were reported. EpSS scores had a mean baseline score of 14.7 ± 3.1, dropping to a postoperative mean score of 9.1 ± 1.1 ($p < 0.01$), indicated that daytime somnolence was problematic in the preoperative setting but normalized after surgery. PSQI scores showed a similar improvement from a baseline of 10.9 ± 2.8 to a postoperative score of 5.3 ± 2.2 ($p < 0.01$) indicating disturbed sleep quality before surgery that normalized after FESS, although 14 (26.4%) patients still had a PSQI score >5 after surgery.

Pearson correlation scores were found to be weak positive relationships between SNOT-22 and PSQI both preoperatively and postoperatively ($\rho = 0.27$ and 0.23, respectively, $p < 0.05$). A moderate positive correlation was seen in the preoperative and postoperative EpSS and PSQI scores ($\rho = 0.33$ and 0.39, respectively, $p < 0.01$) showing internal consistency within that data.

Discussion

The effect of CRS on QOL is beyond dispute and forms a major impetus for patients to prefer surgery in many cases to an offer of ongoing medical therapy. Sleepiness in this patient population is a major source of QOL deterioration. Although prior reports exist regarding the effect of FESS on sleepiness in a general CRS grouping,[4,5] to the best of our knowledge this study forms the first report of the effect of FESS on sleep outcomes in a CRS population without polyposis. Our novel data have indicated that not only does FESS improve sleep outcomes in this patient population, but also that it does without the associated need for correction of nasal obstruction. FESS was able to improve overall sleep quality as well as decrease daytime somnolence. The impact of this 2-fold improvement on sleep can hardly be overstated.

Symptoms of excessive sleepiness and daytime fatigue are hallmarks of CRS. Various studies have put forth hypotheses as to the cause of this association, with some evidence suggesting a molecular etiology (inflammatory cytokines found in infection and inflammation) causing alterations in rapid-eye-movement (REM) sleep phases, which in adults is the phase of sleep associated with memory consolidation.[5] Considerable literature links the loss of REM sleep to increasing comorbidity, increasing pain perception, and psychiatric disturbance (memory and cognition loss).[9] Because it is known that the effects of CRS are not only local but also systemic, and that furthermore, it is also known that FESS improves systemic cytokines levels by decreasing disease burden, it makes sense that FESS should correspondingly improve sleep outcomes. This has yet to be demonstrated via biochemical analysis; the data from our study can serve as an impetus for future work in that direction.

It is interesting to note that a sizeable proportion of patients in our series (26.4%) still had a PSQI score >5 after surgery despite this same group having decreased their SNOT-22 scores. This indicates that they still had a level of sleepiness after surgery that may not have related to their CRS in the first place. Although we had excluded patients from the study who had a known sleep disorder, it is possible that certain latent conditions still had an effect on sleep. Equally possible is that the level of clinical improvement in CRS does not correlate precisely with that of sleep improvement. The level of improvement in sleep-specific symptoms may not reflect that seen in disease-specific outcomes.

Our study has several weaknesses. First, there was no formal sample size calculation performed, rather a convenience sample was used over the year of data collection. Hence the study may be underpowered and the results should be interpreted in that light. Second, because of this relatively small sample size we did not specifically analyze the various possible PSQI subdomains—there may be useful data to glean there in future work. There was no parallel matched-control arm in this study so we cannot make comments regarding how sleep outcomes may have change in a related but unoperated population over the study timeframe. Six months may not be a long enough duration of data inspection to reveal a meaningful long-term relationship between FESS and sleep improvements—longer-term recording would be useful to see if the positive impact on sleep outcomes is sustained. Finally, all data was collected at a tertiary care institution (as evidenced by the higher rate of revision surgery being performed), and may not be entirely generalizable to care at community practices.

Conclusion

The results of our study have shown that in a population of patients with CRS but without polyposis or nasal obstruction, FESS significantly improved sleep outcomes and normalized sleep QOL for 85.7% of the patients in our series. The severity and phenotype of sleepiness in patients with CRSsNP is likely broad in spectrum and further investigation should be done in this area. The novel information identified in our study can be used for patient counseling, surgical planning, and might also be helpful to inform third-party payers as to indications for FESS.

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