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Original Research Article

Impact of functional endoscopic sinus surgery on pulmonary function, sleep quality, and sinonasal quality of life in sinonasal polyposis patients

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ABSTRACT

Background: To compare pulmonary function, sleep quality, and sinonasal quality of life parameters in patients undergoing conservative management and those undergoing post-functional endoscopic sinus surgeries (FESS).
Methods: A total of 60 patients were included in the study, 30 in each group i.e. medically managed labelled as Group 1 and surgically managed labelled as Group 2 and the groups were matched evenly taking care of different variables. Lund-Mackay endoscopic score and radiological score pre- and post-operatively were obtained. Spirometry was done 1 week before surgery and at postoperative 6 weeks. Endoscopic sinus surgery was performed under general anaesthesia. Nasal packing was removed 24 hours postoperatively and discharged on post-op day 1. Follow-up was done at the 1st, 3rd, and 6th post-op weeks. SNOT 22, PSQI, and PFT were repeated at the end of 6 weeks.
Results: There was significant improvement in PSQI score in medically managed patients but not much difference was seen in SNOT 22 score. A significant difference statistically was seen in both PSQI and SNOT 22 scores of surgically managed patients. Patients managed with maximal medical therapy showed improvement in FEV1/FVC after 6 weeks but it was not significant statistically, whereas patients who underwent surgery had statistically significant improvement in all three values of FEV1, FVC, and FEV1/FVC.
Conclusions: By employing pulmonary function tests (PFT), the research unveils objective evidence of underlying lower airway involvement in CRSwNP patients, even in the absence of overt clinical symptoms.

Keywords: FESS, Unified airway disease, SNOT 22, PSQI, PFT

INTRODUCTION

The human respiratory tract is divided into the upper and lower respiratory tract which share a close relationship concerning the coexistence of diseases. Chronic rhinosinusitis (CRS) is identified by mucosal inflammation of the nose and paranasal sinuses lasting for more than 12 weeks or 3 months.[1] Pathologic conditions of the upper airway have been shown to influence pathologic conditions and function of the lower airway, leading to the development of the unified airway model as reviewed by Krouse et al.[2] It has become increasingly clear that respiratory inflammation affects the upper and lower airways. Both epidemiologic and pathophysiologic links have been described among diseases such as allergic rhinitis, chronic rhinosinusitis, and asthma. Because common processes of airway inflammation are seen in these various respiratory illnesses, physicians who frequently diagnose upper airway diseases such as rhinitis and rhinosinusitis encounter patients with asthma daily. In many of these patients, however, the presence and severity of asthma are unappreciated. Otolaryngologists, who traditionally have not been primary caregivers for asthma, need to become more familiar with its signs and symptoms. This is especially important as asthma often overlaps with upper airway disorders, such as allergic

rhinitis and acute or chronic rhinosinusitis, which these specialists frequently manage. Although numerous studies have described a relationship between upper and lower respiratory tract diseases, PFTs in patients with upper respiratory tract diseases has not been fully examined.

Of the pulmonary function tests, forced spirometry variables like forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1) and the ratio of FEV1/FVC are particularly important in assessing the lower airways. Hence, the relationship between ESS (primarily a surgery for the upper airway) and PFT (a test for the lower airway) is still an area that can be studied further; thereby making the current study an opportunity to add more data to the said relationship.

METHODS

The study was conducted at Artemis Health Institute, Sector 51, Gurugram, Haryana. The study population included patients who underwent medical therapy and Functional Endoscopic Sinus Surgery (FESS) for sinonasal polyposis in the ENT department of Artemis. It was designed as a prospective comparative study with a duration of 12 months or until the required sample size was achieved, whichever was earlier. The total study size was 60 patients with 30 patients in medical group and 30 patients in surgical group.

Inclusion criteria

All patients in age group 18 years and above undergoing maximal medical therapy and FESS for sinonasal polyposis and patients in age group 12-18 years with parental/ guardian consent.

Exclusion criteria

All patients less than 12 years and 12-18 years without parents' consent, History of nasal surgeries, Pulmonary symptoms and lung pathology not related to allergy and asthma were excluded from the study.

Informed written consent was taken from each patient and a detailed history and clinical examination was done. Lund-Mackay endoscopic score and radiological score pre and post operatively were obtained. Spirometry was done 1 week prior to surgery and at postoperative 6 weeks.

Endoscopic sinus surgery was performed under general anaesthesia as per Messer Klinger technique, (anterior to posterior approach) with patient in reverse Trendelenburg position.

Nasal packing removed 24 hours post operatively and discharged on post op day 1. Follow up done at 1st, 3rd and 6th post op weeks. SNOT 22, PSQI and PFT were repeated at the end of 6 weeks.

Statistical analysis

A data collection form containing a list of parameters and risk factors was duly filled on the day the patient was enrolled in the study. Local anaesthesia in the form of 10% xylocaine spray was used and was sprayed into the nostrils. A 0-degree rigid nasal endoscope was introduced into the nasal cavity, and a complete examination was performed to describe the extent of polyp involvement. The following parameters were recorded: serum IgE levels, SNOT-22 score, PFT, PSQI, and CT severity score. The data collection form also included a section in which common symptoms of sinusitis were listed.

Sample size

For the prospective observational study, the sample size required can be calculated according to the following formula

$$n = \frac{Z^2 * \sigma^2}{d^2}$$

Where, n=Total sample size, Z=SNV at=5%=1.96 and α=1%=2.58, D=standard deviation from previous/pilot study, d=absolute error based on previous study or researcher corresponding to effect size.

Calculation

For the prospective observational study, at 95% confidence level with appropriate effect size and a statistical power of 80% the expected standard deviation in population is 0.16 and with 4% absolute error from the previous studies. Keeping these values for the calculation of the sample size, our required sample size will be:

$$n = 61.4 \cong 62$$

Therefore, our required sample size for the study will be 62. All major data analysis packages as well as spreadsheets, such as Microsoft Excel and SPSS are used as per requirement. For all statistical tests, the p value is taken less than 0.05 which indicates the valid evidence for statistical significance of the data.

RESULTS

A total of 60 patients were included in the study, 30 in each group i.e. medically managed labelled as Group 1 and surgically managed labelled as Group 2 and the groups were matched evenly taking care of different variables (Figure 1 and 2).

The major presenting symptom in Group 1 was Headache (40%) whereas it was Nasal obstruction (40%) in Group 2. The CT score for Group 1 was equally shared between 0-10 and 11-20, whereas the Endoscopic score was between 4-7(53%). Compared to Group 1, 53% of Group 2 patients had CT scores of 11-20, and 63% had

endoscopic severity of 8-12. There was significant improvement in PSQI score in medically managed patients but not much difference was seen in SNOT 22 score (Table 1).

Table 1: PSQI and SNOT 22 score comparison of medically managed patients at 0 and 6 weeks.

Group 1	Pre-treatment	Post-treatment	P value
PSQI	5.86	4.8	P<0.05
SNOT 22	15.76	13.8	P>0.05

Table 2: PSQI and SNOT 22 score comparison of surgically managed patients at 0 and 6 weeks.

Group 2	Pre-operative	Postoperative	P value
PSQI	7.46	4.8	P<0.05
SNOT 22	17.76	13.8	P=0.05

Table 3: FEV1, FVC, and FEV1/FVC comparison of medically managed patients at 0 and 6 weeks.

	Pre-treatment (SD)	Post-treatment (SD)	P value
FEV1	2.483 (0.24)	2.666 (0.23)	P<0.05
FVC	2.605 (0.23)	2.676 (0.23)	P>0.05
FEV1/FVC	67.54	70.58	P>0.05

Table 4: FEV1, FVC, and FEV1/FVC comparison of surgically managed patients at 0 and 6 weeks.

	Pre surgery (SD)	Post surgery (SD)	P value
FEV1	2.386 (0.25)	2.666 (0.23)	P<0.05
FVC	2.549 (0.21)	2.676 (0.23)	P<0.05
FEV1/FVC	67.84	72.58	P<0.05

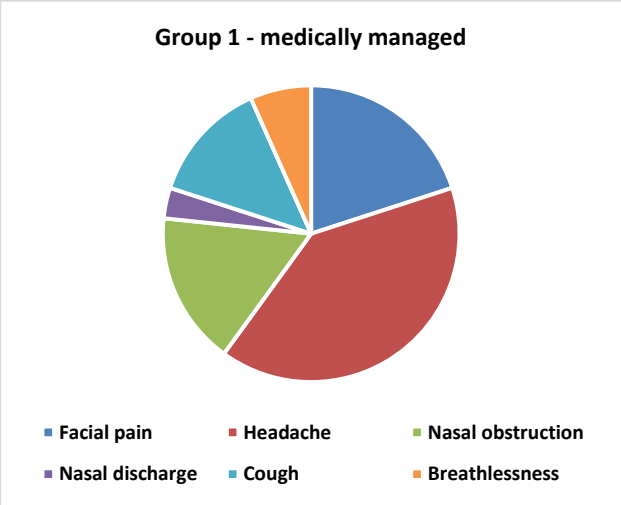

Figure 1: Pie chart showing major symptomatology in medically managed patients.

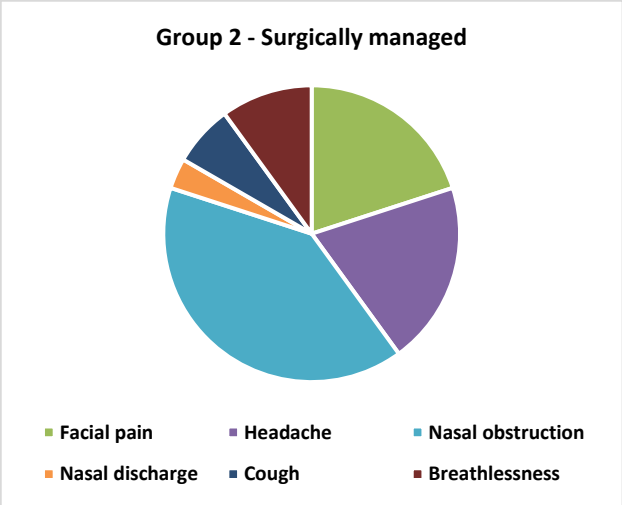

Figure 2: Pie chart showing major symptomatology in surgically managed patients.

However, a significant difference statistically was seen in both PSQI and SNOT 22 scores of surgically managed patients (Table 2 and 3).

Patients managed with maximal medical therapy showed improvement in FEV1/FVC after 6 weeks but it was not significant statistically, whereas patients who underwent surgery had statistically significant improvement in all three values of FEV1, FVC, and FEV1/FVC (Table 4).

DISCUSSION

Rhinosinusitis indeed has a substantial impact on quality of life, often causing discomfort, pain, and difficulty in breathing or sleeping. It can also lead to decreased productivity due to symptoms such as fatigue, difficulty concentrating, and missed workdays. Antibiotics are commonly prescribed for rhinosinusitis, particularly when it's believed to be caused by bacterial infection, but overuse of antibiotics can contribute to antibiotic

resistance and may not always be necessary. Effective management often involves a combination of treatments tailored to the specific needs of the individual, including medications, nasal irrigation, and in some cases, surgery.[3] Ragab et al identified a diverse spectrum of lower airway involvement in 60% of adult patients with chronic rhinosinusitis (CRS) who did not respond to medical treatment. This involvement manifests in various ways: some patients exhibit overt symptoms such as asthma, while others experience non-manifest indications like bronchial hyperreactivity. This nuanced understanding highlights the complex interplay between upper and lower airway conditions in CRS patients and underscores the importance of comprehensive management strategies tailored to individual needs.[4] The study also demonstrated that nasal polyps are a risk factor for lower airway involvement. In our study, headache (40%) was the most common symptom encountered in Group 1. This was followed by facial pain (20%), and nasal obstruction (17%). Nasal obstruction was the most common symptom (40%) in Group 2. This was followed by headache in (20%), and nasal facial pain/pressure in (20%) cases.

The study by Ragab et al identified commonalities in symptoms that parallel findings from a study conducted by Abdalla et al This correlation underscores the consistency and reliability of the observed symptomatology across different research cohorts. Such convergence strengthens the evidence base regarding the symptom profile associated with chronic rhinosinusitis and its potential impact on lower airway function.[5] In this study maximum number of patients (53%) presented when the disease was in a moderate stage (i.e., endoscopic score of 4-7 and CT score of 11-20). In a study conducted by Wang et al, 51.3% of the patients had a CT score in the range of 24-4.[6] Similarly, 12 (40%) cases had a score in the range of 5-8 in a study by Singh et al.[7] Also similar findings were noted by Bhattacharya et al.[8]

While patients treated with maximal medical therapy exhibited some improvement in FEV1/FVC after 6 weeks, this improvement did not reach statistical significance. In contrast, patients who underwent surgery experienced statistically significant improvements in all three parameters: FEV1, FVC, and FEV1/FVC. These results show the potential benefits of surgical intervention in managing CRS, particularly in cases where maximal medical therapy alone may not provide sufficient improvement in respiratory function. Surgical approaches such as endoscopic sinus surgery (ESS) can effectively address underlying sinus pathology and contribute to improvements in pulmonary function

Thus, ESS helps improve the severity of the nonclinical lower airway disease too. These findings are by the study by Singh et al in a study done by Ragab et al, it was found that the 6 and 12-month postoperative FEV1 percent (% of predicted) showed a significant increase.[4] The study conducted by Nakamura et al focusing on the effects of sinus surgery on asthma in aspirin triad patients revealed an important correlation between pre- and post-operative FEV1 scores and asthma severity. This correlation underscores the significance of assessing pulmonary function both before and after sinus surgery, particularly in individuals with aspirin triad, which encompasses aspirin-exacerbated respiratory disease (AERD).[6] In cases of chronic rhinosinusitis with nasal polyposis (CRSwNP), the function of the nasal cavity is compromised. Nasal polyps can obstruct the nasal passages, hindering the airflow and bypassing the primary functions of the nasal cavity. These functions include cleaning, warming, and humidifying the inhaled air, as well as serving as a barrier against pathogens and foreign particles.

When nasal polyps obstruct the nasal passages, these essential functions are disrupted. As a result, the inhaled air may not be adequately filtered, warmed, or humidified before reaching the lower airways. Additionally, the loss of protective mechanisms in the nasal cavity, such as mucociliary clearance and the secretion of mucus with antimicrobial properties, can increase the susceptibility to respiratory infections and exacerbate inflammation in the lower airways.[9] In their study, Shturman-Ellstein et al investigated the impact of nasal breathing versus mouth breathing on pulmonary function in patients with asthma during exercise or hyperventilation. They found that pulmonary function worsened significantly when participants breathed through their mouths compared to nasal breathing. This highlights the importance of nasal breathing in maintaining optimal respiratory function, particularly in individuals with asthma. Nasal breathing helps to filter, warm, and humidify the inhaled air, while also promoting better airflow regulation and gas exchange in the lungs.[10] The precise mechanism underlying the improvement of pulmonary function tests (PFTs) observed among patients with chronic rhinosinusitis (CRS) after endoscopic sinus surgery (ESS) remains unclear. However, it's plausible that part of the improvement following ESS stems from the removal of trigger areas in the nasal and sinus cavities.

While the exact mechanisms are still being elucidated, the observed improvements in PFTs post-ESS underscore the complex interplay between the upper and lower airways in CRS and highlight the potential benefits of addressing upper airway pathology in improving overall respiratory health.[11] Our study also showed a significant improvement in the FEV1/FVC ratio six weeks after surgery, indicating the impact of ESS in alleviating monosymptomatic lower airway obstruction. This improvement may also be attributed to the postoperative use of intranasal corticosteroid sprays, which can substantially reduce upper and lower airway responses to intense triggers.

Limitations

This study is limited by its small sample size, short follow-up duration, and non-randomized design, which

may introduce selection bias. Additionally, the lack of long-term outcome assessment, limited control of confounding variables such as asthma severity and postoperative medication use, and reliance on subjective outcome measures restrict the generalizability and strength of the conclusions.

CONCLUSION

This study illuminates a critical aspect of chronic rhinosinusitis with nasal polyps (CRSwNP), shedding light on the often-overlooked connection between this condition and lower airway disease. By employing pulmonary function tests (PFT), the research unveils objective evidence of underlying lower airway involvement in CRSwNP patients, even in the absence of overt clinical symptoms. Furthermore, the study underscores the transformative impact of endoscopic sinus surgery (ESS) in addressing both nasal and lower airway manifestations of CRSwNP. The significant enhancements observed in PFT parameters post-surgery underscore the profound efficacy of ESS in alleviating not only nasal symptoms but also the broader spectrum of airway afflictions.

These findings serve as a clarion call for a holistic approach to managing CRSwNP, recognizing the intricate interplay between upper and lower airway health. By addressing both aspects of the disease through interventions like ESS, clinicians can strive towards comprehensive management strategies that optimize patient outcomes and enhance overall respiratory well-being.

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