

## Original Research Article

# Evaluation of the benefits of functional endoscopic sinus surgery on bronchial asthma in patients with concomitant nasal polyposis

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## ABSTRACT

**Background:** It is important to understand the relationship between diseases of the upper and lower respiratory tracts because of the prevalence of nasal polyp and asthma, their impact on patients' lives, the resultant burden on the health care system, and the potential benefits of functional endoscopic sinus surgery. Objective of the study was to evaluate the benefits of functional endoscopic sinus surgery (FESS) on bronchial asthma in patients with concomitant nasal polyposis.

**Methods:** A total of 30 patients having nasal polyposis with asthma were taken up in the study. Patients were evaluated in reference to radiographic study of nose and PNS, pulmonary function by spirometry and asthma symptoms by ACT score. FESS was performed in all patients. Post-surgery spirometry and ACT score was done at 3 and 6 months.

**Results:** Maximum patients belonged to the age group of 35-49 years. When compared pre and post-operative ACT score, we observed a mean of 15.7 (pre-operative), 13.6 (at 3 months) and 19.8 (at 6 months). FEV1% score was 74.6 pre-operatively, which was 90.2% at 3 months and 95.5% at 6 months of follow up.

**Conclusions:** FESS has a positive influence in the lower airways function of asthmatic patients. Recorded improvement of the subjective and objective parameters measured, should not only be attributed to alleviation of upper airway symptoms and to concomitant improvement of a patient's quality of life, but also to the positive influence of FESS on the intrinsic mechanisms.

**Keywords:** Functional endoscopic sinus surgery, Bronchial asthma, Concomitant nasal polyposis, Beneficial effects

## INTRODUCTION

Over the past two decades, there has been an increasing awareness of the inter relationship between inflammatory disease of the upper and lower airway. Both epidemiological and physiological data suggest that the respiratory tract from the middle ear mucosa, through the nose and sinuses, and into the pulmonary tree behave as an integrated unit.<sup>1</sup> Pathophysiological processes which affect one component of this integrated system often concurrently impact other portions of the airway, and overtime, isolated disease in one area can expand to involve other areas also. This interdependence of the

upper and lower respiratory tracts has led to the concept of the unified airway, a model for understanding and framing inflammatory processes that affect the respiratory system.<sup>1</sup>

The interrelationship between the disease of nasal polyposis (NP) and asthma was examined thoroughly, and numerous epidemiological and pathophysiological links were found tying these two common conditions. In fact, the coexistence of these two processes was felt to be so frequent that this panel recommended that when considering a diagnosis of nasal polyp or asthma, an evaluation of both upper and lower airway should be

made.<sup>1</sup> It was found in the patients of nasal polyposis that 30% of those referred to ENT department and in more than 70% of those referred to allergy department had asthma.<sup>2</sup>

Nasal polyposis is a chronic inflammatory disease in the nasal and paranasal mucosa and a disease in itself with an unknown etiology.<sup>3</sup> The symptoms of nasal polyposis includes nasal congestion, nasal discharge, reduction in or loss of smell and substantial impairment in quality of life.<sup>4,5</sup> Nasal polyposis has been shown to be associated with asthma. Samter's triad is a well-known disease characterized by the triad of bronchial asthma, nasal polyps, and intolerance to aspirin and other non-steroidal anti-inflammatory drugs.<sup>6</sup> On the basis of available evidence, medical therapy for NP should begin with daily application of a topical intra nasal corticosteroid (INCS) in conjunction with high volume saline irrigation, and subsequent therapies are based on the patient polyp status, severity of symptoms, and/or quality of life (impairment).<sup>7</sup> In some mild cases presenting for the first time with large polyps, polypectomy can have a long lasting effect. In more severe cases with persistent symptoms, surgery is added to medical treatment in order to reduce the amount of inflammatory tissue, open up the nasal airway and improve ventilation of the paranasal sinuses. This is the reason patients are now-a-days referred to a rhino surgeon for endoscopic sinonasal surgery, preceded by a CT scan examination.<sup>8</sup>

Since the introduction of the "united airway disease" concept, a large body of evidence from clinical epidemiology, pathophysiology, histology, and treatment outcomes has correlated asthma and chronic rhinosinusitis with nasal polyposis (CRSwNP).<sup>9</sup> CRSwNP and asthma frequently coexist, both conditions sharing similar features of inflammation and remodeling.<sup>10</sup> This association has been supported by numerous observations of similar histopathological changes and common inflammatory mediator infiltration.<sup>11,12</sup> Typical histopathological findings of asthma, including airway remodeling (epithelial shedding and basement membrane thickening), eosinophilic infiltration, T-helper cell involvement, and IL-5 production are present in both asthma and CRSwNP, suggesting similar physiopathological processes.<sup>13,14</sup> The association between CRSwNP and asthma patients can be considered from two different perspectives: percentage of asthmatic patients developing CRSwNP and patients diagnosed with CRSwNP and with asthma. Bronchial asthma is more prevalent in patients suffering from CRS.<sup>10,15</sup> On the other hand, patients with asthma have a greater prevalence of CRS than patients without asthma.<sup>16</sup>

Rhinology and sinus surgery have undergone a tremendous expansion since the work done by Messerklinger and Wigand in the late 1970s.<sup>17</sup> Imaging advances, increased understanding of the anatomy and the pathophysiology of chronic sinusitis, and image-guided surgery have allowed surgeons to perform more

complex procedures with increased safety.<sup>18</sup> Currently, Functional endoscopic sinus surgery (FESS) is accepted as the gold standard treatment of nasal polyposis and is an effective surgical modality in treating patients of nasal polyposis. The patient's symptoms either improved or become disease free. This technique has the advantage of allowing good subjective and objective outcomes and is associated with minimum complications.<sup>19</sup> FESS has a positive influence in the lower airways function of the asthmatic patients preventing from triggering asthma symptoms. Recorded improvement of the subjective and objective parameters measured, should not only be attributed to alleviation of upper airway symptoms and to concomitant improvement of a patient's quality of life, but to the positive influence of FESS on the intrinsic mechanisms, which probably control the link between the upper and lower respiratory tract.<sup>17</sup>

It is important to clarify and understand the relationship between diseases of the upper and lower respiratory tracts because of the prevalence of nasal polyp and asthma, their impact on patients' lives, the resultant burden on the health care system, and the potential benefits of functional endoscopic sinus surgery. With this background, the present study was carried out with the objective to evaluate the benefits of functional endoscopic sinus surgery on bronchial asthma in patients with concomitant nasal polyposis.

## METHODS

The present prospective study was conducted in the Postgraduate Department of Otorhinolaryngology, Head and Neck Surgery, SMHS Hospital, associated hospital of Government medical college Srinagar. The study was carried out between August 2015 to December 2016. The study was approved from Institutional Ethics Committee.

A total of 30 patients having nasal polyposis with asthma were taken up in the study. Patients presenting with nasal polyposis and asthma symptoms were evaluated in reference to radiographic study (CT scan) of nose and PNS, pulmonary function by spirometry and asthma symptoms by ACT score.

### **Inclusion criteria:**

- Patients of age group (15-60 years).
- Patients diagnosed as nasal polyposis (unilateral or bilateral) with asthma.

### **Exclusion criteria:**

- Pregnant patients.
- Patients younger than 15 years and older than 60 years.
- Cases with neoplasia.
- Revision cases.

A relevant history was taken from each patient and recorded on the standard proforma designed for the purpose. Complete ENT examination was done. Preoperative CT scan of nose and PNS was done in all cases. NCCT nose and paranasal sinuses. Asthma control test (ACT), a five-item self-administered survey, was used to assess asthma control at the individual patient level.<sup>20</sup> Spirometry was also carried out to measure lung functions.

Functional endoscopic sinus surgery was performed in all patients under general anaesthesia. The same technique was carried out in almost all patients. Extent of procedure was tailored to the extent of sinus-disease as documented by CT scan. Bilateral sinonasal endoscopy was done in all patients before the procedure. Postoperative treatment included broad spectrum antibiotics 2-4 weeks; topical steroids for 6 weeks; and saline nasal spray, 1 puff each nostril twice a day for 12 weeks. Post-surgery (FESS) spirometry and ACT score was done at 3 and 6 months.

The collected data were subjected to statistical analysis using SPSS software package. Data was expressed as absolute numbers with or without percentages, as means with standard deviation or as medians with ranges. Frequency comparisons were performed by chi-square test. A probability value less than 0.05 was considered to denote statistical significance.

## RESULTS

In our study, out of a total of 30 patients maximum patients belonged to the age group of 35-49 years with mean age of 36.4±14.48 years and minimum patients belonged to the age group of <20 years i.e. 10 (33.33%) and 5 (16.67%) respectively. The rest of the results were followed by 9 (30.00%) patients belonging to the age-group of 20-34 years and 6 (20.00%) patients belonging to the age group of >50 years. In our study, we had 21 (70.00%) males and 9 (30.00%) females. In accordance with the dwelling places, we found that majority of our patients belonged to the urban areas i.e. 26 (86.67%) while as 4 (13.33%) were from rural areas (Table 1).

According to Table 1, a total of 29 (96.7%) patients showed <19 pre-operative ACT score while only 1 (3.3%) patient showed >19 pre-operative ACT score. The preoperative FEV1 of our 22 (73.3%) studied patients was <80, in 6 (20%) patients it was 80-90 while as in 2 (6.7%) patients it was >90.

As shown in Table 2, total of 17 (56.7%) patients showed <19 post-operative ACT score at 3 months while as 13 (43.3%) patients showed >19 post-operative ACT score at 3 months. A post-operative ACT score of >19 was observed in 21 (70%) patients at 6 months while as 9 (30%) patients showed <19 post-operative ACT score at 6 months. When compared preoperative ACT score with post-surgery at 3 months and 6 months we have observed a mean of 15.7 (pre-operative), 13.6 (at 3 months) and

19.8 (at 6 months). Comparison between preoperative versus 3 months t value was 8.41 while as preoperative versus 6 months the value was 10.22, which are statistically significant.

**Table 1: Baseline characteristics of study patients.**

| Characteristics    | No. of patients | Percentage (%) |
|--------------------|-----------------|----------------|
| <b>Age (years)</b> |                 |                |
| <20                | 5               | 16.67          |
| 20-34              | 9               | 30.00          |
| 35-49              | 10              | 33.33          |
| >50                | 6               | 20.00          |
| <b>Gender</b>      |                 |                |
| Male               | 21              | 70.00          |
| Female             | 9               | 30.00          |
| <b>Residence</b>   |                 |                |
| Rural              | 4               | 13.33          |
| Urban              | 26              | 86.67          |
| <b>ACT score</b>   |                 |                |
| <19                | 29              | 96.67          |
| >19                | 1               | 3.33           |
| <b>FEV1 (%)</b>    |                 |                |
| <80                | 22              | 73.33          |
| 80-90              | 6               | 20.00          |
| >90                | 2               | 6.67           |

When compared at 3 months the FEV1 score was <80 in 3 (10%) patients, 80-90 in 12 (40%) patients while as it was >90 in 15 (50%) patients. When compared at 6 months none of the patients had FEV1 score <80, 80-90 was observed in 11 (36.7%) patients while as it was >90 in 19 (63.3%) patients. In our study, we have a mean FEV1% 74.6, which was 90.2% at 3 months and 95.5% at 6 months of follow up. Comparison between preoperative versus 3 months t value was 52.37 while as preoperative versus 6 months the value was 65.46, which are also statistically significant (Table 3).

**Table 2: Comparison based on ACT score before and after surgery among study patients.**

| ACT score | Pre-operative |       | Follow-up at 3 months |       | Follow-up at 6 months |    |
|-----------|---------------|-------|-----------------------|-------|-----------------------|----|
|           | N             | %     | N                     | %     | N                     | %  |
| ≤19       | 25            | 83.33 | 17                    | 56.67 | 9                     | 30 |
| >19       | 21            | 70    | 13                    | 43.33 | 21                    | 70 |
| T value   | -             |       | 8.41                  |       | 10.22                 |    |
| P value   | -             |       | <0.001*               |       | <0.001*               |    |

\*Statistically significant difference (p <0.05) in comparison with pre-operative findings.

In our study, we have a mean of 7.9-night time awakening per week, which was 0.63 at 3 months of follow up which was observed to be on further reduction at 6 months of follow up. Comparison between preoperative versus 3 months t value was 27.89 while as

preoperative versus 6 months the value was 31.67, which are again statistically significant (Table 4).

**Table 3: Comparison based on FEV1 (%) before and after surgery among study patients.**

| FEV1 (%)       | Pre-operative |       | Follow-up at 3 months |    | Follow-up at 6 months |       |
|----------------|---------------|-------|-----------------------|----|-----------------------|-------|
|                | N             | %     | N                     | %  | N                     | %     |
| <80            | 22            | 73.33 | 3                     | 10 | 0                     | 0     |
| 80-90          | 6             | 20.00 | 12                    | 40 | 11                    | 36.67 |
| >90            | 2             | 6.67  | 15                    | 50 | 19                    | 63.33 |
| <b>T value</b> | -             |       | 52.37                 |    | 65.46                 |       |
| <b>P value</b> | -             |       | <0.001*               |    | <0.001*               |       |

\*Statistically significant difference ( $p < 0.05$ ) in comparison with pre-operative findings.

**Table 4: Comparison based on night time awakenings before and after surgery among study patients.**

| Period               | Night-time awakening per week |      |         |         |
|----------------------|-------------------------------|------|---------|---------|
|                      | Mean                          | SD   | T value | P value |
| <b>Pre-operative</b> | 7.9                           | 1.67 | -       | -       |
| <b>At 3 Months</b>   | 0.63                          | 0.93 | 27.89   | <0.001* |
| <b>At 6 Months</b>   | 0.17                          | 0.46 | 31.67   | <0.001* |

\*Statistically significant difference ( $p < 0.05$ ) in comparison with pre-operative findings.

## DISCUSSION

This prospective study was done in the postgraduate department of otorhinolaryngology, head & neck surgery, in collaboration with department of chest medicine, Government medical college, Srinagar. Our study group comprised total of 30 nasal polyposis with concomitant asthma patients. All subjects were evaluated in reference to radiographic study (NCCT NOSE & PNS), pulmonary function by spirometry and asthma by ACT score (asthma control test).

The co-existence of sinus disease and bronchial asthma was first noted as far as back as the second century AD by Galen.<sup>21</sup> It was not until 1925 that a casual connection was postulated. Since then, several retrospective and prospective studies examining the concurrence of nasal polyposis in patients with asthma have claimed that rhinosinusitis with nasal polyposis and asthma not only coexist but are pathogenetically linked.<sup>21,22</sup>

Many studies have reviewed the effects of medical and surgical treatments (functional endoscopic sinus surgery) of CRS (chronic rhino sinusitis) with nasal polyposis on the course of bronchial asthma.<sup>21,22</sup> In the recent review of interrelationship of rhinosinusitis and asthma, Corren and Rachelefsky found no randomised controlled trials demonstrating the benefits of sinus surgery on lower airway symptoms or pulmonary function. At best, these authors suggested that long term asthma improves after sinus surgery without defining what elements of the

asthma improve or providing objective statistical support for their conclusion.<sup>21</sup> More recent studies have suggested asthma improvement after FESS as it is considered to be a more physiological approach for sinus operations and has emerged as the surgical procedure of choice for CRS with nasal polyposis. FESS has been carried out in CRS in asthma patients by a large number of workers. Stammberger in 1991 conducted a study on 54 patients with asthma and sinusitis who underwent FESS reported slight to marked subjective as well as objective improvement in 83% of patients.<sup>23-25</sup>

The prevalence rate of nasal polyposis is about 2%. It increases with age, reaching a peak in those aged 50 years and older. The male:female ratio is about 2:1. Nasal polyposis occurs with a high frequency in groups of patients having specific airway diseases.<sup>26</sup> In our study, out of a total of 30 patients maximum patients belonged to the age group of 35-49 years and minimum patients belonged to the age group of <20 years i.e. 10 (33.3%) and 5 (16.7%) respectively. The rest of the results were followed by 9 (30%) patients belonging to the age-group of 20-34 years and 6 (20%) patients belonging to the age group of >50 years. Our results are consistent with findings of Nair et al, who had 24 (34.28%) males and 46 (65.7%) females of the age group 19-57 years.<sup>27</sup> Another study done by Elmonem et al in 2013 enrolled total of 24 patients in which; 6 (66.67%) were males and 8 (33.33%) were females, their age ranged from 22 to 58 years with a mean age  $39 \pm 4$  years. Among those 15 (62.5%) patients were below 40 years while 9 (37.5%) patients were above 40 years; his results are consistent with the findings of our study.<sup>28</sup>

In accordance with the dwelling places, we found that majority of our patients belonged to the urban areas i.e. 26 (86.7%) while as 4 (13.3%) were from rural areas. Our results are in agreement with the observations of Jie et al according to whom geographic differences exist in asthma susceptibility around the world.<sup>29</sup> The reason for the differences in asthma prevalence in rural and urban areas may be due to the fact that populations have different lifestyles and cultures, as well as different environmental exposures and different genetic backgrounds. Variability in urban-rural prevalence of asthma and asthma-related symptoms has been observed in many parts of the world (Nguyen et al).<sup>30</sup> Several authors of international studies have reported that exposure of sensitized asthmatics to allergens affected asthma prevalence and morbidity in urban vs. rural areas. Residents living in urban areas are more likely to experience asthma respiratory symptoms than those living in rural areas.<sup>31,32</sup>

All the subjects in the study were documented as having asthma by ACT score and spirometry. In our study, a total of 29 (96.7%) patients showed <19 preoperative ACT score while as only 1 (3.3%) showed >19 preoperative ACT score with a mean of 15.7. A total of 17 (56.7%) patients showed <19 postoperative ACT score

at 3 months while as 13 (43.3%) patients showed >19 postoperative ACT score at 3 months with a mean of 18.6. A postoperative ACT score of >19 was observed in 21 (70%) patients at 6 months while as 9 (30%) patients showed <19 postoperative ACT score at 6 months with a mean score of 19.8. The improvement was statistically significant with a p value of <0.001. Our results are consistent with, Sonkiya et al who observed in their prospective, controlled study that undergoing FESS showed a significant decrease in the use of anti-asthmatic drugs, overall asthma control including ACT scores ( $p < 0.001$ ).<sup>1</sup> They observed a mean preoperative ACT score of 11.40, 23.48 at 3 months follow up and a mean postoperative ACT score 24.84 at 6 months. In a similar study done by Chen et al on 24 patients of chronic rhinosinusitis with nasal polyps and asthma, who underwent FESS (functional endoscopic sinus surgery) found significant improvement in ACT and L-K (Lund-Kennedy) score. The preoperative mean in their study was 15.6, which improved to 19.2 and 21.6 at 3<sup>rd</sup> and 6<sup>th</sup> month respectively; which are in accordance with our results.<sup>33</sup>

In our study patients we evaluated asthma preoperatively and postoperatively with the help of spirometry and have a mean FEVI of 74.6, which was 90.2 at 3 months and 95.5 at 6 months of follow up. Mean FEVI showed significant improvement after FESS. The improvement in mean FEVI was statistically significant with a  $p < 0.001$ . Batra et al reported a significant improvement in lung function (FEVI) and a reduction in oral corticosteroid use after FESS in 17 patients with nasal polyps and concomitant oral corticosteroid dependent asthma.<sup>34</sup> Nishioka et al found 76.39 as the mean preoperative FEVI, 92.3 was observed in their patients on 3 months follow up which was 98.22 at 6 months postoperative follow up; results in above studies are in accordance with our results.<sup>35</sup>

During sleep, the airways tend to narrow, which may cause increased airflow resistance. This may trigger night time coughing, which can cause more tightening of the airways. Increased drainage from sinuses also triggers asthma in highly sensitive airways. Sinusitis with asthma is quite common.<sup>36</sup> In our study, we have a mean of 7.9 night time awakening per week, which was 0.63 at 3 months of follow up which was observed to be on further reduction at 6 months of follow up. The improvement in night time awakening was statistically significant with a p value of <0.001. Postoperative all our studied patients had a reduction in hospital visits by 80% which is consistent with the findings of Manning et al who found that children with CRSwNP and asthma ( $n=14$ ) who underwent FESS had a decreased number of asthma hospitalizations and missed school-days.<sup>37</sup> Other authors also have observed that asthma patients undergoing FESS for CRSwNP had a significant improvement in pulmonary function and a reduction of systemic medication, respectively.<sup>34,38</sup> In FESS trials, all nasal outcomes (symptoms and pulmonary function test results)

and quality of life improved significantly.<sup>37</sup> Our results are also in accordance with the findings of Nishioka et al wherein they found mean of 8.3 night time awakening per week preoperatively, which reduced to a mean score of 0.48 at 3 months follow up and at 6 months there was further reduction in night awakening per weeks i.e. 0.08.<sup>1</sup>

## CONCLUSION

In our study we concluded that FESS has a positive influence in the lower airways function of asthmatic patients. Recorded improvement of the subjective and objective parameters measured, should not only be attributed to alleviation of upper airway symptoms and to concomitant improvement of a patient's quality of life, but also to the positive influence of FESS on the intrinsic mechanisms, which probably control the link between upper and lower respiratory tract. In spite of our results regarding the effect of sinus surgery on improving asthma and nasal polyposis, a longer follow-up period may illustrate different results. Therefore, studies with longer follow-up periods are recommended in future. Also, comparing the outcome of asthma in different sinusitis pathologies requires larger sample sizes to completely define the diversity of the variables.

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