Cystic Fibrosis and Endoscopic Sinus Surgery

Relationship Between Nasal Polyposis and Likelihood of Revision Endoscopic Sinus Surgery in Patients With Cystic Fibrosis

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Objectives: To observe the extent of nasal polyposis endoscopically in a cystic fibrosis population before the first surgical intervention and to grade the extent using a modified Malm scale, to observe patients prospectively and record the need for revision endoscopic sinus surgery (ESS), and to compare this among the individual polyp grading groupings.

Design: Retrospective medical record review of data collected prospectively.

Setting: Tertiary care hospital.

Patients: Forty-nine consecutive patients with a clinical preoperative diagnosis of cystic fibrosis and sinusitis.

Main Outcome Measures: Using a modified Malm scale, the extent of polyps was prospectively graded into 3 groups before the first surgical intervention. The number of patients needing revision ESS and the mean time to revision ESS were compared among the 3 groups.

Results: Forty-nine consecutive patients underwent ESS between 1992 and 2007. We used a 3-stage system for extent of polyposis: 16 patients were noted to have no polyps (grade A), 14 had mild polyposis (grade B), and 19 had extensive polyposis (grade C). During the study, 14 patients required revision surgery: 3 with mild polyposis and 11 with extensive polyposis. Mean time to revision surgery was 39.7 months for those with grade B and 23.8 months for those with grade C. In the overall statistical analysis, the rate of revision ESS was significantly different among the 3 groups (P < .001). In pairwise comparisons, there were significant differences between those with grades A and C (P < .001) and between those with grades B and C (P = .04) and a trend toward significance between those with grades A and B (P = .052). There were no complications from ESS.

Conclusion: Preoperative grading of nasal polyposis in patients with cystic fibrosis can help assess the future likelihood of revision ESS.


Cystic Fibrosis (CF) is caused by a mutation in the CF transmembrane conductance regulator gene on the long arm of chromosome 7. This defect alters the transmembrane passage of the chloride ion across cell membranes, resulting in multisystemic dysfunction that can lead to chronic respiratory tract infections, pancreatic insufficiency, and malnutrition. Nasal obstruction and chronic rhinosinusitis are otolaryngologic manifestations of the disease. Altered viscoelastic properties of mucus that result in bacterial colonization, particularly of Pseudomonas aeruginosa, are thought to contribute to the impaired ciliary clearance seen in patients with CF. This ciliary clearance dysfunction can result in obstruction of the sinus ostia, leading to chronic sinusitis and mucosal edema, leading to sinonasal polyposis and nasal obstruction. However, not all patients with CF develop nasal polyposis.

There are several reasons to consider endoscopic sinus surgery (ESS) in patients with CF. The prevalence of sinus disease in this population approaches 100% according to a combination of signs, symptoms, and radiologic findings: more than 90% of patients with CF show radiologic evidence of sinus mucosal disease. Sinonasal disease can lead to significant morbidity in these patients, placing them at an increased risk for pneumonia, acute exacerbations, and frequent hospitalizations. Approximately 20% to 25% of patients with CF require sinus surgical...
intervention at some point. In addition, surgical treatment of the paranasal sinuses is often recommended as a preventive and preparatory measure for lung transplant candidates because a major cause of death after lung transplantation is pneumonia resulting from P aeruginosa, whose origin is likely to be the paranasal sinuses.

Endoscopic sinus surgery has been shown to be safe and effective for the treatment of paranasal sinus disease in patients with CF. As treatments for CF continue to improve, patients are living longer and quality-of-life issues are coming more to the forefront. Life expectancy has dramatically improved during the past 40 years. In 1969, the average age of survival was 14 years. By 1987, the mean age of survival was 23 years, and by 2006, the mean survival age had increased further to 37 years.

Although several studies have addressed symptomatic outcomes after sinus surgery in CF, it is a chronic disease of mucociliary transport, and even after successful surgery, infection, obstruction, and polyposis can recur. Furthermore, the number of study participants and the length of follow-up in previous studies of sinus surgery for CF are limited. These facts lead some surgeons to question whether ESS has long-term benefits based on the underlying disease and the perception of “eventual failure.”

It is known that computed tomographic (CT) severity (ie, extent of mucosal disease) does not correlate with symptom severity in patients with chronic rhinosinusitis. Almost all patients with CF show CT abnormalities, but not all have symptoms of sinusitis or require ESS. Medical and surgical treatment of sinusitis in patients with CF is based on symptoms and overall status, including pulmonary status and infection frequency. Findings from CT may remain abnormal after sinus surgery, even when symptoms, pulmonary status, and infection frequency are all improved. Although CT severity, and, therefore, the extent of mucosal disease, is not associated with symptom severity at any point in time, we set out to determine whether anatomic severity—in this case, the presence and extent of nasal polyposis—might predict future outcomes after sinus surgery. If so, that prognostic information could be helpful to physicians in the management of this challenging disease.

**METHODS**

A retrospective medical record review was performed of consecutive patients with CF and chronic sinusitis requiring surgery seen between 1992 and 2007. The inclusion criteria were a confirmed clinical preoperative diagnosis of CF and chronic sinusitis requiring surgery.

All surgical procedures in this series were performed by a single experienced surgeon (M.M.A.). The same indications for surgery were used throughout the study and were based on symptoms and overall status, including pulmonary status, rather than on endoscopic or CT findings. Surgical intervention was performed after conservative medical measures were exhausted. Conservative medical measures included long-term nasal corticosteroid treatment, nasal saline use, and multiple courses of oral antibiotics, as individually determined by one of us (M.M.A.), frequently in a culture-directed manner. Most of these patients had symptoms of nasal obstruction, nasal discharge, and postnasal drip. Less common symptoms included headache and facial pain. Nasal obstruction and the extent of mucosal nasal disease were evaluated by CT. There were no noted significant discrepancies between CT/endoscopic findings and symptoms because many patients with CF presented with similar symptoms of nasal discharge, nasal obstruction, and postnasal drip. Although there was a range in the severity of the symptoms, each patient underwent surgical intervention only after maximal medical intervention failed to improve his or her individual symptoms. Given the young age at presentation of this patient population, none of the patients had truly adapted to their symptoms. The same surgical technique (including the use of powered instrumentation) was used throughout this series. Most patients received a 2- to 3-week course of culture-directed oral antibiotics postoperatively. No patients had catheters placed in the maxillary sinus for irrigation.

Indications for revision surgery were similar to initial indications for surgical intervention. Those who underwent previous surgical intervention and either continued to have symptoms or whose preoperative symptoms recurred during postoperative follow-up were treated with conservative medical management as stated previously herein. These patients proceeded to revision surgery only after medical measures failed to improve their symptoms.

Rigid endoscopic nasal examination was performed before the first surgery, and the degree of nasal polyposis was graded according to a modified Malm scale: grade A, no polyps; grade B, mild polyposis without nasal obstruction or a solitary polyp from the antrum; and grade C, extensive nasal polyposis causing nasal obstruction. All office visits were also performed by the same physician (M.M.A.), with consistent medical record documentation. Clinical data were extracted from the medical record, specifically, demographic data, initial stage of polyposis, and dates of surgery.

Statistical analysis comparing the need for revision surgery by polyp stage was performed using the chi-square test for trend, and then individual pairwise comparisons were performed using a standard chi-square test. Means were compared using the t test or 1-way chi-square test.
We identified 49 patients with CF who underwent ESS between 1992 and 2007. These patients underwent 77 ESS procedures. There were 22 males (45%) and 27 females (55%), and mean age at first surgical intervention was 10.8 years (range, 2-39 years). Four of the 49 patients had had a single previous surgical intervention at a different institution and subsequently had further surgical interventions as part of this series. Of these 4 patients, 1 was noted to have a limited polypectomy with revision surgery within 1 year. The other 3 patients had revision surgery 2, 4, and 6 years after their initial surgery at an outside institution. Two of these patients had extensive polyposis, and 1 had moderate polyposis. None of these patients had multiple operations before this study.

Mean total follow-up was 7.3 years (range, 1.3-15.0 years). Seventy-seven separate ESS procedures were performed, and there were no major complications, such as orbital injury or cerebrospinal fluid leak. During follow-up, 3 patients died of complications associated with CF, and 1 patient received a lung transplant. The 3 deaths were patients who did not have any revision sinus surgery and were observed for 5, 7, and 9 years. The lung transplant patient (grade B) had 1 revision surgery before transplantation and had none for 4 years after.

Regarding polyp stage just before surgical intervention, 16 patients (33%) had grade A (no polyps), 14 (29%) had grade B (moderate nonobstructing polyps), and 19 (39%) had grade C (extensive polyposis). Mean age at first surgical intervention was as follows: grade A patients, 11.4 years; grade B patients, 11.5 years; and grade C patients, 9.7 years. These differences were not significant (P = .64).

Fourteen patients (29%) required revision ESS during follow-up; 9 (64%) were male and 5 (36%) were female. We compared the rate of revision surgery by initial polyp stage. None of the patients without polyps (grade A) required revision surgery (mean follow-up, 6.0 years). Three of 14 patients (21%) with grade B polyps required revision surgery (mean follow-up, 8.7 years), and 11 of 19 patients (58%) with grade C polyp disease required revision surgery (mean follow-up, 7.8 years). The comparison between all groups was significant (χ² = 14.48, P < .001). In pairwise comparisons between groups, there were significant differences between those with grades A and C (χ² = 13.508, P < .001) and between those with grades B and C (χ² = 4.388, P = .04). There was a trend toward significance between those with grades A and B (χ² = 3.81, P = .052).

Revision surgery details are summarized in the Table. Fourteen patients underwent 28 revision ESS procedures, for a mean of 2 revision procedures per patient. The only patients requiring more than 1 revision had grade C polyps at initial surgery. Mean time to revision surgery for all the patients was 27.1 months. Patients with grade B polyps had revision surgery a mean of 39.7 months after initial surgery, and those with grade C polyps had revision surgery at a mean of 23.8 months. This difference was not significant (P = .25).

Previous studies7-12 have shown that ESS is safe and effective for the treatment of paranasal sinus disease in patients with CF. Many studies addressing symptom outcomes after sinus surgery have shown good results.3,9-11,13-18 In fact, one study17 advocated aggressive sinus surgery in patients with complete nasal obstruction caused by nasal polyposis. Another study17 showed a reduced need for hospital stays in the 6 months after ESS.

The only outcome addressed in the present study was the need for revision surgery. In CF, this is an important outcome because mucosal problems are long-term, and minimizing the number of procedures and associated risk is an important consideration. Note that although this is technically a retrospective review, the data were collected prospectively and treatment protocols were consistent throughout, with the same experienced surgeon. We also report a long follow-up period.

We used a modified polyp grading system during the study, so it is difficult to compare polyp severity with that of other studies. However, the overall prevalence of polyps in patients with CF has been reported to vary from 36% to 57%.1,25 We report a higher overall prevalence of endoscopically diagnosed polyps (67%), but this sample comprised patients who underwent sinus surgery, not an entire population of patients with CF. So the higher prevalence in the present series is not surprising.

The overall rate of revision surgery in the present study was lower than anticipated (<30%). In patients with moderate or severe polyposis, the rate of revision surgery was 42%, which is slightly below the reported rates of 50% by Rowe-Jones and Mackay18 and 58% by Yung et al.25 Some researchers have reported overall rates of revision surgery as high as 72%.23 We also found that polyp severity at initial surgery was strongly predictive of the need for revision surgery, with patients with more extensive polyps requiring revision surgery more frequently. However, even in the group with the most extensive polyps, the revision rate, with follow-up of almost 8 years,
was 58%. This compares favorably with the 75% revision rate of severe nasal polyposis by Rowe-Jones and Mackay. As expected, in this group the time to revision surgery was also shorter. Overall, these rates and frequencies of revision surgery are probably lower than might have been predicted because some authors have discussed the possibility of yearly sinus surgery in patients with CF and an eventual revision rate of almost 100%.

In the present series, patients with minimal polyp disease who underwent ESS did not require revision sinus surgery during mean follow-up of 6 years. The differences between groups of polyp severity were significant, which is consistent with other studies. One study found that CT findings are a significant predictor of the need for revision sinus surgery, with more significant disease on CT (ie, higher Lund-McKay scores) being associated with a higher rate of revision surgery. However, CT shows paranasal sinus abnormalities in most patients with CF, and one study comparing CT performed preoperatively and postoperatively showed no significant difference, making CT a poor measure of outcome. Other studies have shown that endoscopic examination severity is correlated with CT severity measured using the Lund-McKay or other CT staging systems, which makes clinical sense because endoscopic examination and CT assess mucosal disease.

Two major studies of ESS in patients with CF, one by Rowe-Jones and Mackay and one by Yung et al, have examined similar issues. Rowe-Jones and Mackay noted 46 patients with a mean follow-up of 26 months. Most of their patients were adults, with a mean age of 23 years at first surgical intervention. They noted a 50% chance of needing revision ESS during follow-up. The present study has similar numbers of patients but differs in patient age at surgical intervention (10.8 vs 23 years) and follow-up (7.3 years vs 28 months). Yung et al had fewer patients at presentation (n = 23) and surgical intervention (n = 12). Their age at first surgical intervention was 8 years, similar to the present study, with a mean follow-up of 4 years.

The present study, therefore, yields 3 major advantages over previous studies. First, the larger population (49 surgical patients) compared favorably with the 46 patients of Rowe-Jones and Mackay and the 23 patients of Yung et al. Second, the present study has a much younger initial age at intervention than does the study by Rowe-Jones and Mackay (10.8 vs 23 years) but is similar to that in the study by Yung et al (10.8 vs 8 years), making it the largest study of its kind in the pediatric CF population. Third, the extended follow-up of 7.3 years is significantly longer than the 28 months in the study by Rowe-Jones and Mackay and 4 years in the study by Yung et al. These 3 separate points strengthen the conclusions of this study and make it a unique contribution to the literature.

We report no complications after ESS in the present series, which is lower than in some other studies but consistent with series of ESS for patients without CF. As in this series, ESS in patients with CF is usually performed in children, and there are no reports of adverse effects of ESS on facial growth.

In summary, we found that the extent of polyposis at the time of initial surgery predicted the need for future revision surgery. This might seem obvious or expected, but in fact, it is an important finding and not necessarily intuitive. There is a range of severity of sinus involvement in patients with CF and, in all cases, patients have abnormal mucosa before and after surgery. So, it is not necessarily expected that the severity of mucosal disease would indicate the need for more frequent surgery. And, in this series, as in many others, patients underwent surgery based on symptom severity only. Although CT severity might not accurately predict symptoms at the time, other series (in patients without CF) have found that CT severity can predict future outcomes. A plausible explanation for that finding is that the extent of mucosal disease or number of sinuses involved might be a manifestation of the underlying burden of disease or the patient’s intrinsic inflammatory response, and, therefore, greater CT severity and mucosal disease burden would predict future outcomes, such as the need for revision surgery.

The present study also found that with several years of follow-up, the overall revision rate was not as high as expected per previous studies. This implies that thorough ESS does not always result in prompt disease recurrence and the need for revision surgery. Furthermore, because revision surgery was performed when symptoms (and overall status) worsened, that means that ESS was effective at improving sinonasal symptoms and overall status for long periods. These periods between surgical procedures were shorter in many patients with extensive polyposis but not in all patients, and this ability to prognosticate could be helpful to patients and physicians.

One weakness of this study is its retrospective nature, although the treatments were standardized throughout. In addition, the nature of the data collection means that many variables that would be of interest for further analysis, such as pulmonary function data, presence of comorbid conditions (such as laryngopharyngeal reflux), microbiology of sinusitis, and possibly genotype, were unavailable. The strengths of the study include the standardized treatment protocol, with only 1 surgeon; the large sample (49 patients) undergoing ESS, one of the largest studies of sinus surgery in the CF literature (and in the pediatric CF literature); and consistent, good follow-up.

In conclusion, in patients with CF, preoperative grading of nasal polyposis at the initial surgical intervention can help predict the future need for revision ESS and the interval between revision surgical procedures.
REFERENCES