

## Effectiveness of Kupferberg Classification-Based Treatment Protocol in Post Operative Management of Allergic Fungal Rhinosinusitis

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### ABSTRACT

Background: Allergic fungal rhinosinusitis (AFRS) is a chronic condition managed surgically with functional endoscopic sinus surgery (FESS), but effective postoperative care is essential to prevent recurrence. This study evaluates the effectiveness of Kupferberg classification-based management in AFRS postoperative care.

Methods: A total of 65 AFRS patients underwent FESS with polypectomy, followed by a Kupferberg classification-guided steroid regimen. Patients were assessed at POD#5, POD#20, and monthly up to 6 months for symptom improvement and recurrence rates.

Results: Early improvement was seen at POD 5 and POD 20 (mean scores: 0.47, 0.48), but recurrence reached 50.8% by POD 6th month, correlating with poor compliance and inadequate maintenance therapy.

Conclusion: The Kupferberg classification-based protocol aids early symptom control but is insufficient in preventing long-term recurrence. Enhancing adherence strategies through extended steroid tapering and telemedicine follow-ups may improve outcomes.

**Keywords:** *Kupferberg, Treatment Protocol Post Operative Management CAD/CAM, Allergic Fungal Rhinosinusitis*

### INTRODUCTION

Allergic fungal rhinosinusitis (AFRS) is a chronic sinus condition where the immune system reacts to fungal spores, typically from species like *Aspergillus*, present in the sinuses.<sup>[1]</sup> Unlike invasive fungal infections, the fungi do not directly invade tissues but trigger an allergic response that causes inflammation and thick mucus production. This results in common symptoms such as chronic nasal congestion, post-nasal drip, facial pain, headaches, and a reduced sense of smell.<sup>[5]</sup> AFRS is most often seen in individuals with pre-existing allergic conditions, such as asthma or allergic rhinitis, and the immune reaction is mediated by IgE antibodies.<sup>[4]</sup>

Diagnosis typically involves imaging (like CT scans), identifying fungal elements in sinus cultures, and elevated IgE levels.<sup>[3]</sup> Treatment focuses on reducing inflammation with corticosteroids, both topical and oral, and possibly antifungal medications. Surgery may be necessary to remove fungal debris or clear blocked sinuses. Long-term management may include allergy treatments like immunotherapy to address the underlying allergic response and prevent recurrences.<sup>[5]</sup>

Patients with allergic fungal rhinosinusitis (AFRS) typically exhibit a distinct pattern of recurrent nasal polyps and the accumulation of fungal mucus. And thus management of AFRS is by functional endoscopic sinus surgery with meticulous removal of polyp, along with regular follow-up to prevent the reformation of polyps.<sup>[4]</sup>

The Kupferberg classification is a system used to categorize chronic rhinosinusitis (CRS) based on the presence of certain features, particularly when evaluating sinus conditions related to inflammation and infection.<sup>[2]</sup> It helps in guiding the management of chronic sinus diseases, especially those that involve fungal infections, like allergic fungal rhinosinusitis (AFRS).

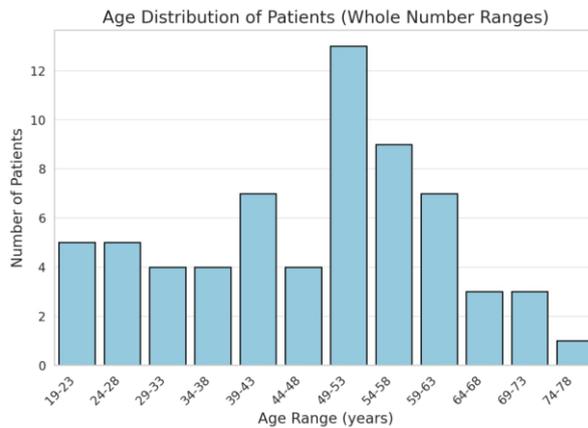
In this study we assess the Effectiveness of Kupferberg classification-based treatment protocol in post operative management of allergic fungal rhinosinusitis.

**METHODOLOGY:**

Data collection begins with a thorough clinical evaluation, where symptoms such as chronic rhinosinusitis, nasal congestion, post-nasal drip, facial pain, reduced sense of smell, and recurrent nasal polyps are assessed, along with any history of allergic conditions like asthma or allergic rhinitis. Next, imaging studies such as a CT scan are performed to check for sinus opacification, thickened mucus, and fungal debris or fungal balls, while an MRI may be used to assess soft tissue changes and the extent of polyp involvement. Laboratory tests include checking for elevated serum IgE levels, indicating an allergic response. Nasal endoscopy is then performed to visualize nasal polyps and fungal material, and in some cases. AFRS is diagnosis and management surgically by FESS with polypectomy. Pre operative and post operative steroid therapy is given. Post operative follow up visits at POD#5, POD#20, and 1 monthly visit for next 6 months. At each visit (Endoscopic) Kupferberg classification based topical with or without systemic steroid therapy was given. The findings documented, data thus collected, and analysis done.

**RESULTS:**

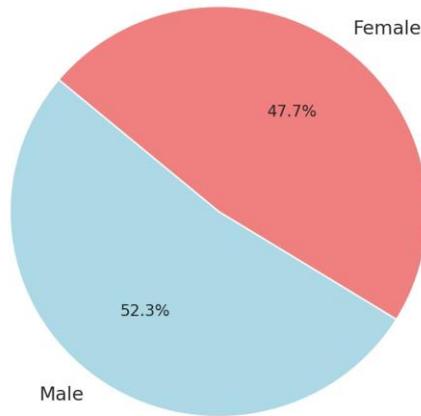
Demographic Analysis



Age Range	Number of Patients
19-23	5
24-28	5
29-33	4
34-38	4
39-43	7
44-48	4
49-53	13
54-58	9
59-63	7
64-68	3
69-73	3
74-78	1

A total of 65 patients were included in the study, with a mean age of  $46.86 \pm 13.94$  years (range: 19–75 years). The majority of the patients were male (60%), while females constituted 40% of the study population. The wide age range suggests that AFRS is prevalent in both younger and older adults, though most cases were seen in middle-aged individuals.

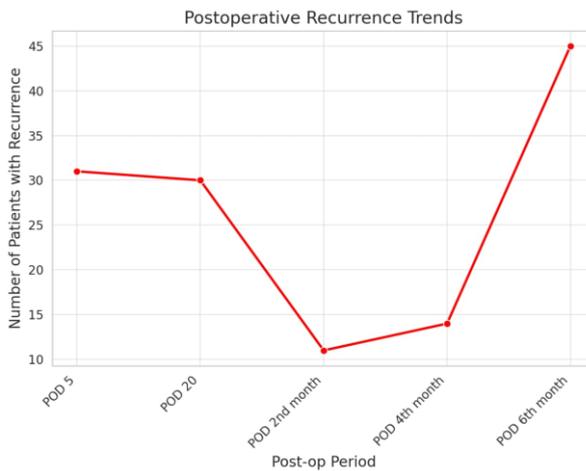
Gender Distribution of Patients



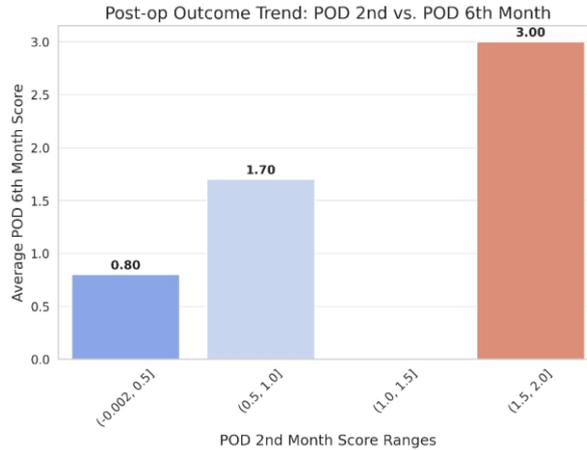
Gender	Number of Patients
Male	34
Female	31

Gender-based analysis showed significant differences in early postoperative improvement. Females demonstrated better recovery at POD 5 compared to males ( $p = 0.009$ ), while males showed better improvement at POD 2nd month ( $p = 0.026$ ). However, by POD 6th month, gender differences were no longer statistically significant, suggesting that both genders eventually reached similar long-term outcomes.

**Postoperative Improvement Trends**



Post-op Period	Number of Patients with Recurrence
POD 5	31
POD 20	30
POD 2nd month	11
POD 4th month	14
POD 6th month	45



POD 2nd month	POD 6th month
< 0.5	0.8
(0.5, 1.0]	1.7
(1.0, 1.5]	
(1.5, 2.0]	3

The Kupferberg classification-based postoperative management for allergic fungal rhinosinusitis (AFRS) demonstrated initial improvement in symptoms but showed limitations in long-term recurrence prevention. Analysis of 65 patients (mean age:  $46.86 \pm 13.94$  years, 60% male, 40% female) revealed that early postoperative follow-ups (POD 5 and POD 20) showed significant improvement, with a mean improvement score of 0.47 (SD = 0.28) and 0.48 (SD = 0.32), respectively. However, by POD 2nd month, improvement declined to 0.19 (SD = 0.26), and further variability was noted at POD 4th month (0.26, SD = 0.33), suggesting a period of potential recurrence or delayed response to steroid therapy. By POD 6th month, recurrence was observed in 33 patients (50.8%), with 1.10 mean variability (SD = 0.97), indicating that while some patients achieved full recovery, others relapsed significantly. Correlation analysis highlighted that POD 2nd month outcomes were the strongest predictor of POD 6th month results ( $r = 0.49$ ), suggesting that patients who showed early improvement had a higher chance of sustained recovery. Despite early symptom control, recurrence trends peaked after POD 2nd month, affecting 6 patients initially and reaching 33 by the 6th month, demonstrating that while Kupferberg-based management helped in short-term improvement, it was insufficient in preventing late-stage recurrence. Given these findings, steroid therapy adjustments around POD 20 and POD 2nd month could be optimized to reduce long-term recurrence rates, ensuring better postoperative outcomes in AFRS patients.

The significant relapse observed in 50.8% of patients (33 out of 65) by POD 6th month suggests that poor maintenance therapy and patient compliance played a crucial role in postoperative outcomes. The initial postoperative period (POD 5 and POD 20) showed consistent improvement (mean scores: 0.47 and 0.48, respectively), indicating that early-stage treatment was effective. However, the decline in improvement by POD 2nd month (0.19) and POD 4th month (0.26) suggests that patients may have deviated from the prescribed steroid regimen, missed follow-ups, or had inadequate long-term therapy adjustments.

Additionally, the correlation between POD 2nd month improvement and POD 6th month outcomes ( $r = 0.49$ ) highlights that patients showing good compliance early on had better long-term recovery, while those who missed follow-ups or had inconsistent therapy adjustments were more likely to relapse. The highest follow-up default rate (6%) was seen at POD 2nd month, indicating that patients experiencing symptom relief might have discontinued or improperly followed maintenance therapy.

**DISCUSSION:**

Allergic fungal rhinosinusitis (AFRS) is a chronic sinus disorder triggered by an exaggerated immune response to fungal spores, commonly from species like *Aspergillus* <sup>(1)</sup>. Unlike invasive fungal infections, it does not involve direct tissue invasion but instead results in persistent inflammation and excessive mucus buildup <sup>(5)</sup>. Symptoms typically include nasal

congestion, facial pressure, post-nasal drip, headaches, and a diminished sense of smell. Individuals with asthma or allergic rhinitis are more prone to AFRS, as the condition is mediated by Immunoglobulin E (IgE), triggering an allergic response (4).

Diagnosing AFRS involves multiple steps. CT scans are often used to assess sinus abnormalities, while sinus cultures help identify fungal elements (5). Elevated IgE levels further confirm an allergic reaction (1). Managing AFRS primarily focuses on controlling inflammation and the immune response. Corticosteroids, both oral and topical, are the mainstay of treatment, with antifungal medications sometimes included (7). Severe cases may require surgical intervention to remove fungal debris and clear obstructed sinuses. Since recurrence is common, long-term strategies such as immunotherapy are often necessary to manage underlying allergies (12).

A distinguishing feature of AFRS is the frequent formation of nasal polyps and the accumulation of thick fungal mucus (6). Functional endoscopic sinus surgery (FESS) is often performed to clear obstructions and remove polyps (8). However, ongoing monitoring is crucial, as polyps tend to reappear, requiring regular follow-ups to ensure proper sinus function (11). When it comes to classifying chronic rhinosinusitis (CRS), the Kupferberg classification system is widely used. This system evaluates key factors such as inflammation severity, sinus function, and the extent of nasal polyps, making it a valuable tool for diagnosing and managing sinus conditions involving fungal infections (2).

In cases of AFRS, the Kupferberg classification helps guide post-surgical care. After surgery, inflammation control and prevention of polyp recurrence become the primary focus (3). This structured classification-based protocol allows healthcare professionals to take a comprehensive approach to treatment, improving both short-term recovery and long-term disease management (9).

Stage	Endoscopic Finding
0	No mucosal edema or allergic mucin
I	Mucosa edema with or without allergic mucin
II	Polypoid edema with or without allergic mucin
III	Sinus polyps with fungal debris or allergic mucin

Studies have supported the importance of these comprehensive treatment strategies. Philpott et al. (2002) introduced a new staging system for AFRS, enhancing the tracking of patients' progress post-operatively (6). Chan et al. (2020) evaluated itraconazole, an oral antifungal drug, finding varying patient improvements (7), while Angrish et al. (2024) suggested itraconazole's potential to defer or substitute surgery in some cases (9). Seiberling et al. (2018) showed that itraconazole decreased recurrence rates and improved symptoms in recalcitrant fungal sinusitis (10). Khalil et al. (2019) and Hashemi et al. (2021) found that preoperative itraconazole reduced recurrence rates and improved cavity conditions in long-term follow-up, highlighting personalized treatment's importance (11,12).

In this study has shows the effectiveness of the Kupferberg classification-based treatment protocol in post-operative management of AFRS. Evaluating patient outcomes, recurrence rates, and overall quality of life will determine if this structured approach offers significant benefits compared to traditional management methods. The findings emphasizes on the important and implications for the standard of care in AFRS, potentially leading to more personalized and effective treatment strategies for patients with this chronic and often challenging condition.

These findings emphasize the need for stricter adherence protocols, improved patient education, and potentially extending systemic or topical steroid therapy beyond the current postoperative regimen. Strengthening compliance strategies—such as reminder systems, telemedicine follow-ups, or extended corticosteroid tapering protocols—could help mitigate late-stage relapses and enhance long-term outcomes for AFRS patients.

**CONCLUSION:**

Kupferberg classification provides a structured approach to AFRS post-op management. Personalized treatment protocols based on severity improve patient outcomes. More research is needed to optimize and validate the classification system. Stricter adherence protocols, better patient education, and extended steroid therapy may improve long-term AFRS outcomes. Compliance strategies like reminder systems, telemedicine follow-ups, and prolonged corticosteroid tapering could help reduce late-stage relapses and enhance postoperative recovery.

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