Section: Otorhinolaryngology

Original Research Article

THE EFFECTIVENESS OF BALLOON SINUPLASTY IN THE TREATMENT OF CHRONIC RHINOSINUSITIS WITH NASAL POLYPOSIS

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ABSTRACT

Background: Chronic rhinosinusitis with nasal polyps (CRSwNP) is a persistent inflammatory condition of the paranasal sinuses characterized by nasal obstruction, facial pressure, hyposmia, and mucopurulent discharge. Conventional treatments, including medical therapy and functional endoscopic sinus surgery (FESS), have long been employed but carry limitations such as recurrence, surgical morbidity, and prolonged recovery times. Balloon sinuplasty, a minimally invasive technique, has emerged as an alternative aimed at restoring sinus drainage while preserving mucosal integrity. This study was conducted to evaluate the effectiveness of balloon sinuplasty in patients with CRSwNP in terms of symptom relief, radiological improvement, and quality of life enhancement.

Materials and Methods: This prospective observational study was conducted at a tertiary care center over a period of 12 months. A total of 60 adult patients diagnosed with CRSwNP, who failed to respond adequately to maximal medical therapy, were enrolled. Balloon sinuplasty was performed targeting the maxillary, frontal, and sphenoid sinuses as indicated. Patients were evaluated preoperatively and at 3 and 6 months postoperatively using the Sino-Nasal Outcome Test-22 (SNOT-22) score, Lund-Mackay radiological staging, and nasal endoscopy findings. Complication rates and need for revision procedures were recorded.

Results: The mean preoperative SNOT-22 score significantly improved from 52.6 ± 10.4 to 18.3 ± 7.5 at 6 months postoperatively ($p < 0.001$). The Lund-Mackay scores also showed marked radiological improvement. Nasal endoscopy revealed a substantial reduction in polyp size and mucosal edema in the majority of patients. Only 2 patients (3.3%) required revision interventions within the follow-up period. No major complications such as cerebrospinal fluid leak, orbital injury, or significant hemorrhage were noted. Patient satisfaction rates were high, with 91.7% of participants reporting symptomatic relief and functional improvement.

Conclusion: Balloon sinuplasty is a safe, effective, and minimally invasive technique for the management of chronic rhinosinusitis with nasal polyps, offering significant symptom relief and radiological improvement with minimal morbidity. It presents a viable alternative to conventional sinus surgery, especially in selected patients with localized disease and favorable anatomy. Further studies with larger cohorts and longer follow-up periods are recommended to validate these findings.

Keywords: Balloon Sinuplasty, Chronic Rhinosinusitis, Nasal Polyps, SNOT-22 Score, Lund-Mackay Score, Minimally Invasive Sinus Surgery, Endoscopic Sinus Procedures.

INTRODUCTION

Chronic rhinosinusitis with nasal polyps (CRSwNP) is a distinct subset of chronic rhinosinusitis, characterized by persistent inflammation of the nasal and paranasal sinus mucosa for a duration of at least 12 weeks, accompanied by the formation of nasal polyps. Patients typically present with nasal congestion, anosmia or hyposmia, facial pressure, and nasal discharge, significantly impacting their quality of life. The pathophysiology of CRSwNP is complex, involving multifactorial etiologies such as environmental allergens, infectious agents, immune dysregulation, and mucociliary dysfunction. Histologically, nasal polyps demonstrate a predominant eosinophilic infiltration, tissue edema, and glandular hyperplasia, distinguishing CRSwNP from other inflammatory sinus disorders.

Conventional management strategies for CRSwNP include maximal medical therapy with intranasal corticosteroids, systemic steroids during exacerbations, and adjunctive use of saline irrigations and antibiotics when indicated. Despite optimal medical treatment, many patients experience recurrent or refractory symptoms necessitating surgical intervention. Functional endoscopic sinus surgery (FESS) has been the traditional surgical approach aimed at restoring sinus ventilation and drainage. Although effective, FESS is associated with surgical morbidity, mucosal trauma, and potential complications such as bleeding, synechiae formation, and prolonged postoperative recovery.

The introduction of balloon sinuplasty has revolutionized the surgical management of chronic rhinosinusitis, offering a less invasive alternative to conventional FESS. Balloon sinuplasty involves the transnasal insertion of a catheter-mounted balloon, which is then inflated to dilate the natural sinus ostia, thereby restoring normal sinus drainage without removing mucosal tissue or bone. This approach preserves the anatomical structures, minimizes intraoperative trauma, and promotes faster healing. Moreover, balloon sinuplasty can often be performed under local anesthesia in an outpatient setting, significantly reducing patient discomfort and healthcare costs.

Although initially approved for chronic rhinosinusitis without polyps, growing evidence suggests that balloon sinuplasty may also be beneficial in selected cases of CRSwNP, particularly when polyps are limited or after partial polypectomy. Studies have indicated that balloon dilation can successfully address sinus ostial obstruction even in the presence of small to moderate-sized polyps, offering symptomatic relief and reducing the need for extensive surgical dissection.

Given the evolving indications and expanding utilization of balloon sinuplasty, it is imperative to critically assess its efficacy specifically in patients with CRSwNP. Understanding its impact on symptom scores, radiological improvement, polyp regression, and the need for revision procedures is essential for appropriate patient selection and counseling.

In this context, the present prospective observational study was undertaken to evaluate the effectiveness of balloon sinuplasty in the treatment of chronic rhinosinusitis with nasal polyps. The study aimed to analyze clinical outcomes in terms of symptomatic improvement, radiological changes, endoscopic findings, complication rates, and overall patient satisfaction following the procedure, thereby providing insights into the role of balloon sinuplasty as a viable option in the multidisciplinary management of CRSwNP.

MATERIALS AND METHODS

This prospective observational study was conducted at the Department of Otorhinolaryngology of Government Medical College and Hospital Janagaon over a period of 12 months, from April 2024 to March 2025. Ethical clearance was obtained from the Institutional Ethics Committee prior to the commencement of the study. Written informed consent was obtained from all participants after explaining the nature, benefits, and potential risks of the procedure.

Adult patients aged between 18 and 65 years who were diagnosed with chronic rhinosinusitis with nasal polyps (CRSwNP) based on clinical evaluation, nasal endoscopy, and computed tomography (CT) findings were included in the study. All participants had persistent symptoms despite undergoing maximal medical therapy, including a minimum of 8 weeks of intranasal corticosteroids, systemic steroids when indicated, and saline irrigations. Patients with extensive polyposis requiring extensive surgical resection, fungal sinusitis, sinonasal malignancies, craniofacial abnormalities, pregnancy, or previous sinonasal surgery were excluded.

A detailed history was taken from each patient regarding symptomatology, duration, previous treatments, and comorbidities such as asthma or aspirin-exacerbated respiratory disease (AERD). Baseline symptom severity was assessed using the Sino-Nasal Outcome Test-22 (SNOT-22) questionnaire. Nasal endoscopy was performed to assess polyp size and nasal cavity status, graded according to the Lund-Kennedy endoscopic scoring system. Radiological evaluation was done with a non-contrast CT scan of the paranasal sinuses, and disease severity was assessed using the Lund-Mackay scoring system.

All eligible patients underwent balloon sinuplasty under general or local anesthesia based on patient preference and extent of disease. A flexible guidewire was introduced into the target sinus under endoscopic visualization, and a balloon catheter was

then advanced over the guidewire. Once appropriately positioned, the balloon was inflated to dilate the natural ostium of the maxillary, frontal, or sphenoid sinus, depending on the involvement. In cases with obstructive polyps at the ostium, limited polypectomy was performed to facilitate balloon access, preserving as much mucosa as possible. The balloon was deflated and removed after adequate dilation was achieved. No extensive tissue removal or bone resection was performed.

Postoperatively, patients were prescribed intranasal corticosteroids, saline irrigations, and antibiotic coverage for 7 days. Regular follow-up visits were scheduled at 1 week, 1 month, 3 months, and 6 months. Repeat nasal endoscopy was performed during follow-up visits to evaluate mucosal healing, residual or recurrent polypoid changes, and ostial patency.

Outcome measures included changes in SNOT-22 scores, changes in Lund-Mackay scores on repeat CT imaging at 6 months, nasal endoscopy findings, complication rates, and the need for revision procedures. Symptomatic improvement was defined as a reduction of at least 50% in SNOT-22 scores. Radiological improvement was considered significant if there was a reduction in the Lund-Mackay score by two or more points. Patient satisfaction was recorded based on subjective feedback during follow-up.

Data were compiled in Microsoft Excel and statistically analyzed using SPSS software version 26.0. Paired t-tests were used to compare preoperative and postoperative SNOT-22 and Lund-Mackay scores. Categorical variables such as complication rates and revision procedures were analyzed using chi-square or Fisher's exact tests. A p-value <0.05 was considered statistically significant.

Thus, the methodology of this study ensured a comprehensive evaluation of the clinical effectiveness and safety profile of balloon sinuplasty specifically in patients suffering from chronic rhinosinusitis with nasal polyps.

RESULTS

A total of 60 adult patients diagnosed with chronic rhinosinusitis with nasal polyps (CRSwNP) were included in the study and underwent balloon sinuplasty. The patients were evaluated based on clinical symptom scores, radiological findings, nasal endoscopy, complication rates, and need for revision procedures over a 6-month follow-up period.

Table 1 shows the age and gender distribution of the study participants. The majority of patients were males in the 31–50 years age group.

Table 1: Age and Gender Distribution

Age Group (years)	Male (n)	Female (n)	Total (n)	Percentage (%)
18–30	10	5	15	25.0%
31–40	13	7	20	33.3%
41–50	12	5	17	28.3%
>50	5	3	8	13.4%

Table 2 presents the distribution of major presenting symptoms. Nasal obstruction and nasal discharge were the most common complaints.

Table 2: Presenting Symptoms

Symptom	Frequency (n)	Percentage (%)
Nasal Obstruction	57	95.0%
Nasal Discharge	49	81.7%
Facial Pressure/Pain	33	55.0%
Hyposmia/Anosmia	38	63.3%

Table 3 shows the baseline mean SNOT-22 and Lund-Mackay scores of the participants before surgery.

Table 3: Baseline Clinical and Radiological Scores

Score Type	Mean ± SD
SNOT-22 Score	52.6 ± 10.4
Lund-Mackay Score	14.2 ± 3.1

Table 4 shows the improvement in mean SNOT-22 scores postoperatively at 3 months and 6 months. Significant improvement was noted at each follow-up.

Table 4: Changes in SNOT-22 Scores Over Time

Time Point	Mean SNOT-22 Score ± SD	p-value
Preoperative	52.6 ± 10.4	
3 Months Post-op	24.5 ± 8.9	<0.001
6 Months Post-op	18.3 ± 7.5	<0.001

Table 5 demonstrates the changes in Lund-Mackay radiological scores at baseline and at 6 months postoperatively. Significant reduction was observed.

Table 5: Changes in Lund-Mackay Scores

Time Point	Mean Lund-Mackay Score ± SD	p-value
Preoperative	14.2 ± 3.1	
6 Months Post-op	7.8 ± 2.7	<0.001

Table 6 shows the grading of nasal polyps endoscopically before and after balloon sinuplasty. Polyp size reduced significantly in the majority of patients.

Table 6: Endoscopic Polyp Grading Pre- and Post-Balloon Sinuplasty

Polyp Grade	Preoperative (n)	6 Months Post-op (n)
Grade 0 (None)	0	34
Grade 1 (Mild)	4	20
Grade 2 (Moderate)	29	6
Grade 3 (Severe)	27	0

Table 7 shows patient-reported satisfaction at 6 months post-procedure.

Table 7: Patient Satisfaction at 6 Months

Satisfaction Level	Frequency (n)	Percentage (%)
Highly Satisfied	35	58.3%
Satisfied	20	33.4%
Partially Satisfied	4	6.7%
Unsatisfied	1	1.6%

Table 8 shows the incidence of postoperative complications. No major complications were reported.

Table 8: Postoperative Complications

Complication Type	Frequency (n)	Percentage (%)
Minor Nasal Bleeding (self-limiting)	5	8.3%
Infection	2	3.3%
CSF Leak	0	0%
Orbital Injury	0	0%

Table 9 shows the revision surgery rate among the study participants. Very few patients required additional procedures.

Table 9: Need for Revision Surgery

Revision Status	Frequency (n)	Percentage (%)
Required	2	3.3%
Not Required	58	96.7%

Table 10 demonstrates the number of sinuses treated per patient during the balloon sinuplasty procedure.

Table 10: Number of Sinuses Dilated per Patient

Number of Sinuses Dilated	Frequency (n)	Percentage (%)
1–2 Sinuses	18	30.0%
3–4 Sinuses	35	58.3%
>4 Sinuses	7	11.7%

Table 11 shows improvement in olfactory function (hyposmia/anosmia) following balloon sinuplasty among patients.

Table 11: Improvement in Olfactory Symptoms

Symptom Improvement	Frequency (n)	Percentage (%)
Complete Recovery	21	55.3%
Partial Improvement	14	36.8%
No Improvement	3	7.9%

Table 12 summarizes the overall clinical success rate based on combined symptomatic, radiological, and endoscopic parameters.

Table 12: Overall Clinical Success Rate

Clinical Success Status	Frequency (n)	Percentage (%)
Successful Outcome	55	91.7%
Partial/Unsuccessful	5	8.3%

Balloon sinuplasty resulted in significant improvement in symptom scores, endoscopic polyp grading, and radiological findings in patients with CRSwNP. It demonstrated a high clinical success rate with minimal morbidity and a very low revision rate, establishing itself as a safe and effective treatment modality in selected cases of chronic rhinosinusitis with nasal polyps.

DISCUSSION

Chronic rhinosinusitis with nasal polyps (CRSwNP) is a challenging clinical condition often associated with significant morbidity, impaired quality of life, and a high recurrence rate even after medical or surgical intervention. Traditionally, functional endoscopic sinus surgery (FESS) has been the mainstay surgical approach for patients refractory to medical management. However, the associated tissue disruption, risk of complications, and lengthy recovery period have prompted the exploration of less invasive alternatives. Balloon sinuplasty has emerged as a minimally invasive technique aimed at restoring natural sinus drainage while minimizing tissue trauma. This study evaluated the effectiveness of balloon sinuplasty in patients with CRSwNP, focusing on symptomatic relief, radiological improvement, and procedural safety.

In the present study, balloon sinuplasty demonstrated significant symptomatic improvement in patients with CRSwNP. The mean SNOT-22 scores showed a substantial reduction from a preoperative value of 52.6 to 18.3 at 6 months postoperatively, indicating a high degree of symptom relief. These findings are consistent with previous clinical observations that balloon dilation provides effective and durable symptomatic benefit in selected cases of chronic rhinosinusitis, including cases complicated by mild to moderate polyposis.

Radiological improvement was equally notable. The mean Lund-Mackay score decreased significantly at 6 months following the procedure. This reflects improved sinus aeration and resolution of mucosal disease, validating the mechanical effectiveness of ostial dilation in promoting natural sinus drainage and reducing inflammation. Balloon sinuplasty's mechanism of action, which preserves mucosal integrity and sinus architecture, likely contributes to its ability to promote long-term radiological and clinical improvement.

Endoscopic evaluation revealed significant regression of nasal polyps in the majority of patients. By addressing the underlying obstruction at the sinus ostia and improving sinus ventilation, balloon dilation may indirectly contribute to reducing mucosal edema and polyp formation, although it is not designed as a definitive procedure for extensive polyp disease. The majority of patients showed either complete resolution or downgrading of polyp size without the need for extensive surgical removal, supporting its use in carefully selected CRSwNP patients with localized disease.

The complication rate associated with balloon sinuplasty in this study was minimal. No major complications such as cerebrospinal fluid leak, orbital injury, or significant hemorrhage were reported. Minor nasal bleeding and localized infection occurred in a small proportion of patients and were managed conservatively. These results reinforce the excellent safety profile of balloon sinuplasty, making it a suitable option even in patients with comorbidities where minimizing surgical risk is crucial.

Patient satisfaction rates were high, with 91.7% of patients reporting significant improvement in symptoms and quality of life. The low revision surgery rate (3.3%) further highlights the effectiveness and durability of balloon sinuplasty outcomes within the follow-up period. Improvement in olfactory function was another significant outcome, with over half of the patients experiencing complete or partial recovery of smell sensation, an important aspect often underemphasized in the assessment of treatment success.

Overall, the findings of this study suggest that balloon sinuplasty offers a safe, effective, and patient-friendly alternative to conventional surgery for the management of CRSwNP, especially in cases where disease extent is moderate and localized. Careful patient selection based on endoscopic and radiological criteria remains essential to optimize outcomes. While balloon sinuplasty may not replace FESS in cases of extensive polyposis or anatomical distortion, it represents a valuable addition to the therapeutic armamentarium for chronic rhinosinusitis management.

CONCLUSION

This prospective observational study demonstrates that balloon sinuplasty is an effective and safe treatment modality for patients with chronic rhinosinusitis with nasal polyps (CRSwNP), particularly in cases with moderate disease severity and favorable anatomical profiles. The procedure resulted in significant improvements in symptom scores, radiological findings, and nasal endoscopic evaluations, with minimal complication rates and a high level of patient satisfaction. The preservation of mucosal structures, reduced postoperative discomfort, and shorter recovery time confer distinct advantages over conventional endoscopic sinus surgery in appropriately selected patients.

Balloon sinuplasty offers a minimally invasive, tissue-sparing alternative that can restore sinus drainage and improve quality of life while minimizing surgical morbidity. Although not a replacement for extensive surgical approaches in cases of severe polyposis, balloon sinuplasty stands as a viable first-line surgical option for localized disease or as part of a hybrid approach when combined with limited surgical debulking.

The findings support the integration of balloon sinuplasty into routine clinical practice for carefully selected patients with CRSwNP. Further large-scale, long-term studies are warranted to validate the durability of symptom relief and to refine patient selection criteria to maximize clinical outcomes.

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