

IMPROVING MODERN DIAGNOSTIC AND TREATMENT APPROACHES FOR CHRONIC RHINOSINUSITIS: CLINICAL, ENDOSCOPIC, AND INSTRUMENTAL ASSESSMENT

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Abstract

Chronic rhinosinusitis (CRS) is a persistent inflammatory disorder of the nasal cavity and paranasal sinuses that significantly affects respiratory function, sleep quality, daily activity, and overall quality of life. The heterogeneous nature of CRS creates substantial challenges in diagnosis and treatment because patients may present with different combinations of nasal obstruction, rhinorrhea, facial pressure, reduction of smell, headache, and systemic manifestations. Modern management therefore requires a comprehensive diagnostic strategy that integrates clinical assessment with nasal endoscopy, computed tomography, and selected laboratory or functional investigations. This article reviews contemporary approaches to the diagnosis and treatment of CRS, emphasizing the complementary value of clinical, endoscopic, and instrumental assessment. Particular attention is given to objective evaluation of sinonasal inflammation, identification of anatomical abnormalities, differentiation between inflammatory phenotypes, and selection of individualized treatment strategies. Conservative therapy remains the foundation of management and includes saline irrigation, intranasal corticosteroids, treatment of associated allergic or inflammatory conditions, and appropriate management of acute exacerbations. In selected patients with persistent symptoms despite optimized medical therapy, endoscopic sinus surgery may be considered. Advanced therapeutic approaches, including biologic agents targeting specific inflammatory pathways, have expanded treatment options for patients with severe uncontrolled disease, particularly those with nasal polyps and type 2 inflammation. An integrated diagnostic and therapeutic algorithm can improve disease characterization, treatment selection, monitoring, and long-term outcomes. The combination of clinical symptoms, endoscopic findings, and imaging results provides a more reliable basis for personalized CRS management than any individual diagnostic method used in isolation.

Keywords: chronic rhinosinusitis, nasal endoscopy, computed tomography, sinus inflammation, nasal polyps, intranasal corticosteroids, endoscopic sinus surgery, biologic therapy, diagnosis, personalized treatment.

1. Introduction

Chronic rhinosinusitis is one of the most common chronic inflammatory disorders affecting the upper respiratory tract. It is characterized by persistent inflammation of the nasal and paranasal sinus

mucosa and may occur with or without the formation of nasal polyps. Although CRS is not usually associated with immediate life-threatening complications, its prolonged course can substantially impair physical, psychological, and social well-being. Persistent nasal obstruction may interfere with normal breathing, while impaired olfaction can affect appetite, food enjoyment, and environmental awareness. Sleep disturbances, fatigue, facial discomfort, and recurrent exacerbations may further reduce patients' productivity and quality of life.

The clinical complexity of CRS results from its multifactorial pathogenesis. Genetic susceptibility, epithelial dysfunction, impaired mucociliary clearance, local anatomical abnormalities, microbial factors, allergy, environmental exposure, and dysregulated immune responses may contribute to disease development and persistence. Consequently, CRS should not be considered a single uniform disease. Different patients may have different inflammatory profiles, anatomical characteristics, symptom patterns, and responses to treatment.

The traditional diagnosis of CRS has largely relied on patient-reported symptoms and physical examination. However, symptoms alone are insufficient to establish the extent and severity of sinonasal inflammation. Nasal obstruction, facial pain, headache, and postnasal drainage may also occur in allergic rhinitis, migraine, dental disorders, viral infections, and other conditions. Objective confirmation of sinonasal disease is therefore essential, particularly when prolonged medical therapy or surgical intervention is being considered.

Nasal endoscopy has become an important component of modern CRS assessment because it allows direct visualization of the nasal cavity, middle meatus, mucosal edema, purulent secretions, crusting, polyps, and other pathological changes. Unlike routine anterior rhinoscopy, endoscopy provides a more detailed examination of anatomically complex areas that are difficult to visualize during conventional examination.

Computed tomography (CT) of the paranasal sinuses remains the principal imaging modality for evaluating sinonasal anatomy and the distribution of inflammatory disease. CT can demonstrate mucosal thickening, opacification of sinus cavities, obstruction of drainage pathways, anatomical variations, and structural abnormalities. Nevertheless, imaging findings should be interpreted together with clinical and endoscopic information because radiological abnormalities may persist in patients with relatively mild symptoms, while symptom severity does not always correspond directly to CT severity.

Recent advances in understanding CRS pathophysiology have also influenced treatment strategies. Rather than applying an identical therapeutic regimen to all patients, clinicians increasingly consider disease phenotype, inflammatory characteristics, presence or absence of nasal polyps, comorbid asthma, previous surgery, and response to conventional therapy. This shift toward individualized management has created opportunities for more precise treatment selection and improved long-term disease control.

The purpose of this article is to examine modern approaches to the diagnosis and treatment of chronic rhinosinusitis, with particular emphasis on the integration of clinical examination, nasal endoscopy, instrumental imaging, and individualized therapeutic strategies.

2. Materials and Methods

The analysis presented in this article is based on a structured review of contemporary clinical approaches to chronic rhinosinusitis diagnosis and treatment. The methodological framework emphasizes the integration of clinical symptoms, objective sinonasal examination, endoscopic assessment, imaging findings, and therapeutic response.

The clinical component includes evaluation of the duration and severity of nasal symptoms. Particular attention is directed toward nasal obstruction, anterior or posterior nasal discharge, facial pressure or pain, reduction or loss of smell, recurrent exacerbations, sleep disturbance, and limitations in daily activities. The duration of symptoms is important because chronic rhinosinusitis is distinguished from acute rhinosinusitis by persistence of disease manifestations over an extended period.

A detailed medical history should include previous episodes of rhinosinusitis, prior sinus surgery, allergic diseases, asthma, sensitivity to medications, smoking or exposure to environmental irritants, dental disease, occupational exposures, and previous treatment. Information regarding the type, duration, and effectiveness of previous therapy is particularly valuable when evaluating patients with persistent or recurrent symptoms.

Objective assessment includes examination of the external nose, anterior nasal cavity, and

nasopharyngeal region. Nasal endoscopy is used when available to provide a more detailed assessment of the sinonasal mucosa. During endoscopic examination, the clinician evaluates mucosal edema, erythema, purulent secretions, polyps, crusting, anatomical obstruction, and changes within the middle meatus and other relevant drainage pathways.

Computed tomography of the paranasal sinuses is used to characterize anatomical and inflammatory abnormalities when objective confirmation is required or when surgical treatment is being considered. The evaluation includes assessment of individual sinus compartments, osteomeatal complex patency, mucosal thickening, fluid accumulation, complete or partial opacification, and anatomical variations that may influence sinus ventilation and drainage.

Where clinically indicated, additional investigations may include allergy assessment, evaluation for asthma and other airway diseases, laboratory investigations, microbiological examination, and assessment of immune or inflammatory conditions. These investigations should be selected according to the clinical presentation rather than performed indiscriminately in every patient.

Treatment assessment is based on symptom improvement, restoration of nasal airflow, improvement of olfactory function, reduction of inflammatory findings on endoscopy, decreased frequency of exacerbations, and improvement in quality of life. For patients receiving prolonged treatment, adherence and correct administration of intranasal medication are also considered important components of therapeutic evaluation.

3. Results

The integrated diagnostic approach demonstrates that no single assessment method can adequately characterize the entire clinical spectrum of chronic rhinosinusitis. Clinical evaluation provides essential information regarding symptom burden and disease impact, while endoscopy and imaging provide objective evidence of local sinonasal pathology.

Patients with CRS commonly present with persistent nasal obstruction and nasal discharge, although the intensity of individual symptoms varies considerably. Reduction of smell is particularly relevant in patients with nasal polyps and extensive inflammatory disease. Facial pressure or discomfort may also be present, although this symptom does not necessarily indicate the severity of sinus inflammation and should be interpreted in the broader clinical context.

Endoscopic examination provides valuable additional information. Edematous mucosa, inflammatory secretions, and polyps may indicate active sinonasal inflammation. In patients with nasal polyposis, endoscopy allows assessment of the size and distribution of polyps and can be particularly useful for monitoring response to medical treatment. Serial endoscopic examinations may demonstrate reduction of mucosal edema and polyp size following effective therapy.

Instrumental imaging further improves diagnostic characterization. CT can reveal disease distribution within individual sinuses and identify structural factors that may contribute to impaired ventilation and drainage. It is particularly valuable before endoscopic surgery because detailed anatomical information assists in planning a safe and targeted intervention.

The results of modern diagnostic evaluation also demonstrate the importance of distinguishing CRS phenotypes. Patients with CRS without nasal polyps may have different clinical and inflammatory characteristics from those with CRS accompanied by nasal polyps. The latter group may demonstrate more extensive mucosal disease, pronounced olfactory impairment, and a greater tendency toward recurrence.

Treatment outcomes are strongly influenced by appropriate disease characterization. Basic medical therapy remains effective for many patients when prescribed correctly and used consistently. Saline irrigation can improve mucociliary clearance and reduce the concentration of inflammatory material within the nasal cavity. Intranasal corticosteroids play an important role in reducing mucosal inflammation and are particularly useful in patients with nasal polyps.

Persistent disease despite optimized medical management may require escalation of treatment. Endoscopic sinus surgery can restore drainage and ventilation pathways, remove obstructive inflammatory tissue, and facilitate delivery of topical medications to the sinonasal mucosa. However, surgery should generally be considered part of a comprehensive treatment strategy rather than a complete replacement for long-term medical management.

Patients with severe uncontrolled CRS, especially those with recurrent nasal polyps and evidence of type 2 inflammation, may benefit from biologic therapies directed against specific inflammatory pathways. Such treatment represents an important development in personalized CRS management.

and may reduce disease burden in appropriately selected patients.

4. Discussion

The diagnosis and treatment of chronic rhinosinusitis have changed substantially with the development of endoscopic techniques, high-resolution imaging, and a more detailed understanding of sinonasal immunology. The modern concept of CRS emphasizes disease heterogeneity and recognizes that similar symptoms may arise from different pathological mechanisms. Clinical examination remains the starting point for assessment. A carefully obtained history can identify characteristic symptoms, associated diseases, environmental triggers, and previous treatment failures. However, symptom-based diagnosis alone may result in overdiagnosis or inappropriate treatment. Objective evidence of sinonasal inflammation is therefore an important component of diagnostic confirmation.

Nasal endoscopy provides a direct assessment of mucosal pathology and has several advantages over conventional examination. It can reveal disease in regions that are difficult to inspect with standard instruments and allows clinicians to monitor inflammatory changes over time. Endoscopy can also help identify patients who require additional investigation or modification of therapy.

One important advantage of endoscopic follow-up is the ability to assess treatment response objectively. Improvement in symptoms may occur before complete resolution of mucosal abnormalities, while some radiological changes may persist after clinical improvement. Repeated endoscopic evaluation can therefore contribute to a more nuanced assessment of disease activity. CT imaging provides complementary information that cannot be obtained through endoscopy alone. The internal anatomy of the paranasal sinuses cannot be directly visualized throughout their entire extent during routine endoscopy. CT allows visualization of sinus cavities, bony boundaries, drainage pathways, and anatomical variations. This is especially important when surgical treatment is being planned.

At the same time, CT should not be interpreted independently of the clinical picture. Structural or mucosal abnormalities can occur in individuals without significant CRS symptoms, and the severity of radiological changes may not correspond precisely with patient-reported disease burden. Excessive reliance on imaging can therefore lead to unnecessary interventions.

The increasing recognition of inflammatory phenotypes has had a major impact on treatment. CRS with nasal polyps frequently demonstrates a type 2 inflammatory profile involving cytokine pathways such as interleukin-4, interleukin-5, and interleukin-13. This biological understanding has supported the development of targeted therapies for patients whose disease remains uncontrolled despite conventional treatment.

Medical therapy continues to form the foundation of CRS management. Isotonic or hypertonic saline irrigation can support mechanical clearance of mucus, allergens, and inflammatory mediators. Correct technique and regular use are important because inconsistent treatment may reduce effectiveness. Intranasal corticosteroids are among the most important pharmacological treatments for CRS. They reduce mucosal inflammation and can decrease the size and activity of nasal polyps. Their clinical benefit depends on appropriate administration and adherence. Patients should therefore receive practical instructions regarding nasal spray technique, positioning, and regular use.

Antibiotics have a more limited role in chronic disease than in acute bacterial infections. Routine prolonged antibiotic administration is generally inappropriate without a specific clinical indication. Antibiotic therapy may be considered in selected situations, such as certain acute exacerbations or documented bacterial complications, but treatment should be guided by clinical circumstances and antimicrobial stewardship principles.

Management of associated diseases is another essential component. Allergic rhinitis, asthma, aspirin-exacerbated respiratory disease, immunological disorders, and other chronic airway conditions may influence CRS severity and treatment response. Coordinated management of upper and lower airway disease can therefore improve overall respiratory health.

Endoscopic sinus surgery is generally considered when significant symptoms and objective disease persist despite appropriate medical treatment. The purpose of surgery is not simply to remove diseased tissue but to improve sinus ventilation and drainage and create conditions that facilitate postoperative topical treatment. Modern functional endoscopic surgery aims to preserve healthy structures whenever possible and provide targeted correction of pathological obstruction.

Postoperative management remains crucial. Saline irrigation and topical corticosteroid therapy are

commonly used after surgery to reduce inflammation, maintain sinus patency, and minimize recurrence. Regular endoscopic surveillance may help identify recurrent inflammation or polyp formation at an early stage.

Biologic therapies represent one of the most significant recent developments in CRS treatment. Monoclonal antibodies directed against key inflammatory pathways may be considered in carefully selected patients with severe uncontrolled disease. These therapies can reduce polyp burden, improve nasal obstruction and smell, and decrease the need for systemic corticosteroids or repeated surgery in appropriate patients. However, their use requires careful patient selection and long-term monitoring.

An individualized treatment strategy should therefore consider symptom severity, endoscopic findings, imaging results, inflammatory phenotype, comorbidities, previous interventions, adherence, and patient preferences. Such an approach is more likely to achieve sustained disease control than treatment based on symptoms alone.

Another important consideration is patient education. CRS is usually a chronic condition that requires long-term management. Patients should understand the expected course of treatment, the importance of adherence, proper nasal irrigation and spray technique, potential triggers, and the need for follow-up. Effective communication can significantly improve treatment adherence and reduce unnecessary escalation of therapy.

Future development in CRS management is likely to focus on biomarkers, molecular phenotyping, artificial intelligence-assisted imaging interpretation, digital symptom monitoring, and increasingly precise targeted therapies. Such innovations may allow clinicians to predict treatment response and identify patients at high risk of recurrence before clinically significant deterioration occurs.

5. Conclusion

Chronic rhinosinusitis is a heterogeneous inflammatory disorder requiring a comprehensive and individualized diagnostic and therapeutic approach. Clinical assessment remains fundamental for identifying characteristic symptoms and evaluating their impact on quality of life, but objective confirmation through nasal endoscopy and appropriate instrumental imaging provides important additional information.

Nasal endoscopy enables direct visualization of mucosal inflammation, secretions, polyps, and anatomical abnormalities, while CT provides detailed information about sinus involvement and internal sinonasal anatomy. The complementary use of these methods improves diagnostic accuracy and assists in treatment planning, particularly when surgical intervention is considered.

Medical therapy with saline irrigation and intranasal corticosteroids remains the cornerstone of treatment for many patients. Management of associated allergic, respiratory, and inflammatory disorders is also essential for achieving sustained disease control. In patients with persistent symptoms and objective disease despite optimized conservative treatment, endoscopic sinus surgery may provide improved sinus drainage and facilitate long-term topical therapy.

For patients with severe uncontrolled CRS, particularly those with recurrent nasal polyps and appropriate inflammatory characteristics, biologic therapy has expanded the therapeutic spectrum and created new opportunities for personalized treatment. Nevertheless, these advanced treatments should be integrated into a broader management strategy rather than used independently.

The most effective modern approach to CRS combines clinical findings, endoscopic assessment, imaging, disease phenotype, comorbidities, previous treatment response, and patient-specific factors. Continued development of molecular diagnostics and targeted therapies may further improve early disease recognition, treatment selection, recurrence prevention, and long-term quality of life in patients with chronic rhinosinusitis.

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