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ENHANCING THE ROLE OF ARTIFICIAL INTELLIGENCE IN THE DIAGNOSIS OF CHRONIC PROLIFERATIVE RHINOSINUSITIS

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Abstract

Background: Chronic proliferative rhinosinusitis, operationally understood in this manuscript as chronic rhinosinusitis with a predominantly proliferative or polypoid mucosal phenotype, remains a diagnostic challenge because symptom burden, endoscopic appearance, computed tomography findings, and inflammatory endotype do not always correlate. Artificial intelligence (AI) is increasingly being used in rhinology to improve radiologic interpretation, endotype prediction, image segmentation, and endoscopic assessment.

Aim: To evaluate the potential of an AI-assisted diagnostic pathway in 130 patients with chronic proliferative rhinosinusitis managed at the Tashkent State Medical University ENT Department.

Methods: This publication-style draft models a prospective observational study in which patients underwent standard clinical assessment, SNOT-22, rigid nasal endoscopy, paranasal sinus computed tomography, and histomorphologic verification where indicated. The AI pathway incorporated CT-based endotype prediction, machine-learning clinical prediction, automated nasal-polyp segmentation from endoscopic images, and integrated risk stratification.

Results: In the modeled cohort, AI assistance improved diagnostic concordance from 81.5% to 92.3%, reduced time to final diagnostic classification from 4.2 ± 1.3 days to 2.5 ± 0.9 days, and decreased the need for additional imaging review from 21.5% to 9.2%. AI-derived composite assessment also improved modeled identification of high-risk recurrent proliferative disease.

Conclusion: AI-assisted diagnosis may improve standardization, early risk stratification, and precision treatment planning in chronic proliferative rhinosinusitis; however, prospective multicenter validation remains necessary.

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Keywords: Chronic proliferative rhinosinusitis; chronic rhinosinusitis with nasal polyps; artificial intelligence; nasal endoscopy; computed tomography; machine learning; endotype prediction; diagnostic algorithm; precision rhinology.

Introduction

Chronic rhinosinusitis is a heterogeneous inflammatory disease of the nose and paranasal sinuses that persists for at least 12 weeks and requires both symptom criteria and objective evidence on endoscopy and/or imaging. EPOS 2020 emphasized that chronic rhinosinusitis should be classified using integrated clinical, endoscopic, and radiologic criteria, while also recognizing the importance of inflammatory endotypes and phenotypes for precision treatment. In the present manuscript, the term chronic proliferative rhinosinusitis is used to denote the proliferative or polypoid mucosal phenotype that clinically overlaps with chronic rhinosinusitis with nasal polyps and related proliferative inflammatory remodeling.

From a practical standpoint, diagnosis remains difficult because symptom intensity, endoscopic polyp burden, tissue eosinophilia, and CT opacification are not always concordant. This mismatch may delay risk stratification, obscure recurrence-prone disease, and complicate treatment planning. Conventional diagnostic workflows therefore depend heavily on expert interpretation and are vulnerable to inter-observer variability.

Artificial intelligence has recently emerged as a promising adjunct in chronic rhinosinusitis. A 2025 scoping review identified 49 AI studies in CRS and found that most addressed diagnosis, endotype subtyping, radiologic assessment, or prognostic prediction. A 2025 systematic review of AI in CRS diagnostic imaging included 20 studies and concluded that AI has significant promise, although validation remains heterogeneous and clinical translation is still evolving.

Recent primary studies illustrate the scope of these developments. Deep learning applied to paranasal sinus CT predicted eosinophilic versus non-eosinophilic CRSwNP endotype in 251 patients with a testing AUC of 0.963. In another study of 437 patients, machine-learning models and a nomogram predicted eosinophilic CRS using routine clinical variables, highlighting peripheral eosinophils and the ethmoid-to-maxillary density ratio on CT as key predictors. Pilot work on nasal

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endoscopy has also shown that AI can automatically identify and segment nasal polyps from video frames with high precision and recall, supporting its future role as a complementary visual diagnostic tool.

Given these advances, an AI-supported diagnostic model may be especially useful in chronic proliferative rhinosinusitis, where the disease course is often driven by mucosal proliferation, inflammatory endotype, and recurrence risk rather than by symptoms alone. The present article therefore provides a publication-style draft of a 130-patient study from the Tashkent State Medical University ENT Department, focusing on methods to enhance the role of AI in diagnosis.

Aim

To assess the diagnostic value of an AI-assisted multimodal pathway for chronic proliferative rhinosinusitis in 130 patients treated at the Tashkent State Medical University ENT Department and to determine its potential influence on early classification, recurrence-risk assessment, and treatment planning.

Materials and Methods

This article is drafted as a modeled prospective observational cohort study involving 130 adult patients with chronic proliferative rhinosinusitis managed at the Tashkent State Medical University ENT Department. For the purposes of this manuscript, the diagnosis was operationally based on persistent sinonasal symptoms longer than 12 weeks, objective evidence on rigid nasal endoscopy and CT, and proliferative or polypoid mucosal disease requiring specialist evaluation.

Inclusion criteria were: age 18 years or older; chronic sinonasal symptoms for at least 12 weeks; endoscopic evidence of proliferative mucosal disease and/or polypoid changes; available CT data; and complete clinical follow-up in the modeled dataset. Exclusion criteria were fungal sinusitis, sinonasal tumors, cystic fibrosis, primary ciliary dyskinesia, granulomatous disease, and insufficient documentation.

All patients were modeled as having undergone a standardized diagnostic work-up that included history taking, symptom-duration documentation, visual analogue scale assessment, SNOT-22 questionnaire, rigid nasal endoscopy, endoscopic nasal-polyp scoring where relevant, and paranasal sinus CT with

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Lund–Mackay scoring. Where tissue sampling was clinically indicated, histomorphologic analysis was also considered in the final classification.

The conventional diagnostic pathway consisted of expert clinical assessment, endoscopy, radiologic interpretation, and multidisciplinary consensus. The AI-assisted pathway added four analytic modules: (1) CT-based deep-learning endotype prediction, conceptually based on previously published ResNet-type imaging models; (2) machine-learning clinical prediction using routinely available variables; (3) automatic or semi-automatic endoscopic identification and segmentation of proliferative lesions; and (4) integrated recurrence-risk stratification combining clinical, radiologic, laboratory, and endoscopic parameters.

The primary outcomes were modeled diagnostic concordance with final integrated diagnosis, time to definitive diagnostic classification, need for additional imaging review, and proportion of patients correctly assigned to high-risk recurrent proliferative disease. Secondary outcomes were agreement between AI-supported and multidisciplinary classification, endotype-oriented treatment allocation, and early clinical response categorization.

Because the original raw dataset was not supplied, the numerical data presented below are modeled values intended to show a publication-grade structure. Statistical comparisons are therefore illustrative only. In a real submission version, these modeled outputs must be replaced by verified patient-level analyses, approved statistical tests, and ethics documentation.

Results

In the modeled cohort of 130 patients, 76 (58.5%) were male and 54 (41.5%) were female. The mean age was 43.7 ± 11.2 years. Bilateral disease was present in 101 patients (77.7%), while 29 (22.3%) had predominantly unilateral proliferative disease. Clinically significant smell dysfunction was recorded in 79 patients (60.8%), and asthma or allergic comorbidity in 44 patients (33.8%). The mean SNOT-22 score at baseline was 47.9 ± 12.6, and the mean Lund–Mackay score was 14.8 ± 4.1.

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Table 1. Baseline characteristics of the modeled cohort

Variable	Value
Number of patients	130
Mean age, years	43.7 ± 11.2
Male, n (%)	76 (58.5)
Female, n (%)	54 (41.5)
Bilateral disease, n (%)	101 (77.7)
Predominantly unilateral disease, n (%)	29 (22.3)
Smell dysfunction, n (%)	79 (60.8)
Asthma/allergic comorbidity, n (%)	44 (33.8)
Mean SNOT-22 score	47.9 ± 12.6
Mean Lund–Mackay score	14.8 ± 4.1

The modeled final integrated diagnosis classified 84 patients (64.6%) as having high-probability proliferative polypoid disease with recurrence-prone features, while 46 (35.4%) had lower-risk proliferative disease. Under the conventional pathway, diagnostic concordance with the final integrated diagnosis was 81.5%. With AI assistance, concordance rose to 92.3%. The mean time from first specialist assessment to final diagnostic classification decreased from 4.2 ± 1.3 days to 2.5 ± 0.9 days, and the need for additional CT review or repeat radiologic consultation decreased from 21.5% to 9.2%.

Table 2. Modeled diagnostic performance of the AI-assisted pathway

Metric	Conventional pathway	AI-assisted pathway
Diagnostic concordance, n (%)	106 (81.5)	120 (92.3)
Time to final classification, days	4.2 ± 1.3	2.5 ± 0.9
Additional imaging review required, n (%)	28 (21.5)	12 (9.2)
Correct high-risk recurrence assignment, n (%)	93 (71.5)	115 (88.5)
Agreement with multidisciplinary classification, n (%)	—	118 (90.8)

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Modeled endotype-oriented treatment planning also improved with AI support. Among the 84 patients ultimately classified as high-risk proliferative recurrent disease, 73 (86.9%) were correctly allocated to intensified anti-inflammatory and closer surveillance pathways in the AI-assisted model, compared with 58 (69.0%) under the conventional pathway. AI-supported endoscopic segmentation further improved consistency in lesion burden estimation and reduced borderline disagreements in polypoid versus diffuse proliferative disease classification.

Table 3. Modeled effect of AI on treatment planning and early follow-up stratification

Outcome	Conventional pathway	AI-assisted pathway
Correct intensified management allocation, n (%)	58 (69.0)	73 (86.9)
Borderline classification disagreement, n (%)	19 (14.6)	7 (5.4)
High-risk recurrence flag raised before treatment, n (%)	61 (72.6)	77 (91.7)
Modeled early response correctly anticipated, n (%)	79 (60.8)	102 (78.5)

Discussion

The modeled findings suggest that AI may add the greatest value not by replacing the rhinologist, but by reducing subjectivity in complex diagnostic synthesis. This is consistent with the current literature. The 2025 CRS scoping review concluded that AI is promising for diagnosis, subtyping, and prognostication, but also noted that most systems remain at an early translational stage. The 2025 systematic review of AI in CRS imaging reached a similar conclusion, emphasizing both the promise of improved diagnostic support and the present lack of standardization across studies.

The strongest published evidence relevant to proliferative or polypoid disease comes from CT-based endotype prediction and machine-learning risk modeling. In the 2024 deep-learning CT study by Du and colleagues, a ResNet-18 model

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predicted eosinophilic versus non-eosinophilic CRSwNP with a testing AUC of 0.963, suggesting that routine CT contains latent inflammatory information beyond conventional human scoring. Likewise, Xiong and colleagues showed in 437 patients that machine-learning approaches using common clinical variables can help predict eosinophilic CRS without biopsy, highlighting the translational potential of AI in noninvasive endotype approximation.

Endoscopic AI also appears increasingly relevant. The pilot study by Rampinelli and colleagues showed that a YOLOv8-based system could detect and segment nasal polyps from endoscopy images with strong precision and recall, indicating that AI can become a useful complementary tool for objective lesion burden assessment. In routine ENT practice, such tools could help standardize serial follow-up, especially in patients with recurrent proliferative mucosal disease.

From a clinical perspective, chronic proliferative rhinosinusitis is exactly the type of disease in which AI may provide value because diagnosis is cumulative rather than single-test based. Symptoms, endoscopy, CT scores, smell dysfunction, tissue eosinophilia, and comorbidity patterns all contribute partial information. An integrated AI model can aggregate these data more consistently than purely intuitive assessment. This may be particularly useful when identifying patients who need intensified therapy, closer surveillance, or endotype-oriented treatment selection.

At the same time, the present draft has important limitations. First, the term chronic proliferative rhinosinusitis is not yet universally standardized in the international literature, so operational definitions should be stated explicitly in any submission version. Second, because the original raw data were not supplied, the current manuscript uses modeled results and cannot be considered a true original clinical report. Third, even in published AI studies, external validation, prospective implementation, and explainability remain incomplete. Therefore, any real journal submission should include validated statistics, ethics approval, real case flow, and transparent model reporting.

Conclusion

In this publication-style draft, AI-assisted diagnosis improved modeled concordance, accelerated classification, reduced the need for additional imaging review, and enhanced recurrence-oriented treatment allocation in patients with

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chronic proliferative rhinosinusitis. The most realistic near-term role of AI lies in integrated decision support that combines CT analysis, endoscopic lesion quantification, and clinical prediction rather than in autonomous diagnosis. To convert this draft into a publishable original article, the modeled values must be replaced by verified patient-level data from the 130-patient Tashkent State Medical University cohort, with full statistical analysis and ethics documentation.

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