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CLINICAL AND MORPHOLOGICAL FEATURES OF RHINITIS IN PATIENTS WITH A HISTORY OF COVID-19

Zoqiyeva Fotima Otkir kizi

Tashkent state medical universitety

Abstract. COVID-19 has caused long-term pathological changes not only in the lower respiratory tract but also in the upper airways, particularly the nasal mucosa. Rhinitis is frequently observed in patients after recovery from COVID-19 and may persist as part of post-viral complications. The aim of this study was to evaluate the clinical manifestations and morphological characteristics of rhinitis in patients with a previous history of COVID-19.

The study included patients who had recovered from COVID-19 and subsequently developed persistent nasal symptoms such as nasal obstruction, rhinorrhea, dryness, burning sensation, and olfactory dysfunction. Clinical examination included anterior rhinoscopy, nasal endoscopy, and symptom assessment. Morphological evaluation was performed using histological examination of nasal mucosal biopsy samples.

The results demonstrated epithelial desquamation, goblet cell hyperplasia, vascular congestion, subepithelial edema, and lymphocytic infiltration in the nasal mucosa. In several cases, microcirculatory disturbances and focal fibrotic changes were identified. Clinically, prolonged nasal obstruction and decreased smell sensitivity were the most common complaints.

These findings indicate that post-COVID rhinitis is associated with persistent inflammatory and structural remodeling of the nasal mucosa. Recognition of these clinical and morphological changes is important for improving diagnosis, treatment strategies, and prevention of chronic upper airway pathology in post-COVID

Keywords: COVID-19, rhinitis, nasal mucosa, histopathology, epithelial desquamation, inflammatory infiltration, vascular congestion, post-COVID syndrome.

Introduction. COVID-19 has become one of the most significant global health challenges of the 21st century, affecting multiple organ systems and producing both acute and long-term complications. Although the primary manifestations of the disease involve the lower respiratory tract, increasing evidence suggests that the upper respiratory tract, especially the nasal cavity, plays a crucial role in the pathogenesis and persistence of post-infectious symptoms.

The nasal mucosa serves as one of the main entry points for COVID-19 because epithelial cells of the nasal cavity express high levels of angiotensin-converting enzyme 2 (ACE2) receptors, which facilitate viral attachment and penetration. Viral invasion of the nasal epithelium leads to local inflammatory reactions, vascular disturbances, epithelial injury, and impairment of mucociliary clearance.

Rhinitis is one of the most common upper airway disorders observed after viral infections and may persist for several months following recovery from COVID-19. Patients frequently report nasal obstruction, rhinorrhea, dryness, burning sensation, sneezing, and olfactory dysfunction. In many cases, these symptoms remain despite the absence of active viral replication, suggesting chronic inflammatory remodeling of the nasal mucosa.

Recent studies indicate that post-COVID nasal pathology may involve prolonged epithelial degeneration, goblet cell hyperplasia, endothelial dysfunction, microvascular congestion, and infiltration of inflammatory cells. Such morphological changes can contribute to chronic nasal dysfunction and reduced local immune protection.

Understanding the clinical and morphological features of rhinitis in patients with a history of COVID-19 is important for improving diagnostic approaches, identifying long-term complications, and developing effective therapeutic strategies for upper respiratory rehabilitation.

Aim of the Study. The aim of this study was to investigate the clinical manifestations and morphological changes of Rhinitis in patients with a previous history of COVID-19, with particular emphasis on identifying structural alterations of the nasal mucosa, inflammatory responses, and functional disturbances associated with post-viral upper respiratory tract pathology.

The study also aimed to evaluate the relationship between persistent nasal symptoms and histopathological changes in order to improve diagnostic accuracy and optimize therapeutic strategies for post-COVID nasal disorders.

Materials and Methods. This study was conducted in patients who had previously recovered from COVID-19 and subsequently presented with persistent symptoms of Rhinitis. A total of 60 patients aged 18 to 65 years were included in the study. The participants were divided into two groups: the main group consisted of patients with a documented history of COVID-19 and chronic nasal symptoms, while the control group included individuals with rhinitis without previous COVID-19 infection.

Clinical Examination.

Clinical assessment included:

- collection of medical history
- evaluation of nasal complaints
- anterior rhinoscopy
- nasal endoscopy
- olfactory function assessment

The main clinical symptoms analyzed were nasal obstruction, rhinorrhea, dryness of the nasal cavity, sneezing, burning sensation, and decreased smell sensitivity.

Morphological Examination. Morphological analysis was performed using biopsy specimens obtained from the inferior nasal turbinate mucosa under local anesthesia.

The tissue samples were fixed in formalin, processed according to standard histological protocols, embedded in paraffin, sectioned, and stained with hematoxylin-eosin.

Microscopic examination evaluated:

- integrity and thickness of the respiratory epithelium

- degree of epithelial desquamation
- condition and distribution of goblet cells
- presence of ciliary damage or loss
- vascular congestion and dilation in the subepithelial layer
- severity of inflammatory cell infiltration
- presence of lymphocytes, neutrophils, and macrophages
- degree of subepithelial edema
- connective tissue proliferation
- focal fibrotic changes
- condition of glandular structures
- microcirculatory disturbances

Microscopic analysis also focused on identifying structural signs of chronic inflammatory remodeling associated with previous COVID-19 infection, particularly persistent epithelial injury and vascular alterations in patients with Rhinitis.

Inclusion Criteria.

The study included patients who met the following inclusion criteria:

- confirmed previous diagnosis of COVID-19 based on polymerase chain reaction (PCR) testing or documented medical records;
- presence of persistent clinical manifestations of Rhinitis lasting longer than 12 weeks after recovery from acute COVID-19 infection;
- age between 18 and 65 years;
- absence of acute infectious disease at the time of examination;
- patient consent to participate in clinical and morphological investigation, including nasal mucosal biopsy.

Patients were selected only if nasal symptoms developed or persisted after the acute phase of COVID-19, allowing evaluation of long-term post-viral upper airway alterations.

Exclusion Criteria. Patients were excluded from the study if one or more of the following conditions were present:

- history of allergic Rhinitis confirmed by clinical or laboratory findings;
- acute upper respiratory tract infection at the time of examination;
- chronic Sinusitis or other chronic inflammatory diseases of the paranasal sinuses;

- autoimmune disorders affecting mucosal tissues;
- severe systemic diseases that could influence nasal mucosal morphology;
- previous nasal surgery or traumatic injury to the nasal cavity;
- use of intranasal corticosteroids, antihistamines, or systemic anti-inflammatory drugs within the previous four weeks;
- refusal to undergo biopsy or incomplete clinical data.

These exclusion criteria were applied to minimize confounding factors and ensure accurate assessment of post-COVID morphological changes in the nasal mucosa.

Statistical Analysis. Statistical processing of the obtained data was performed using standard biomedical statistical methods. Quantitative variables were expressed as mean values (M) with standard deviation (SD), while qualitative indicators were presented as percentages.

Comparative analysis between the main and control groups was carried out using Student's t-test for normally distributed continuous variables. The chi-square test was applied for comparison of categorical data.

The relationship between clinical manifestations and morphological changes of the nasal mucosa was assessed using correlation analysis.

A probability value of $\mathbf{p < 0.05}$ was considered statistically significant.

All statistical calculations were performed to determine the reliability of differences in clinical and histopathological indicators in patients with a previous history of COVID-19 and persistent Rhinitis. **Clinical Features**

Patients with a history of COVID-19 exhibited a spectrum of persistent nasal symptoms indicative of post-viral rhinitis. The most frequently reported clinical manifestations included:

- **Nasal obstruction:** observed in 85% of patients, often bilateral, associated with a sensation of congestion and impaired airflow.
- **Rhinorrhea:** intermittent or persistent watery nasal discharge was present in 70% of cases.
- **Nasal dryness and burning sensation:** reported by 65% of patients, often accompanied by local irritation and discomfort.
- **Olfactory dysfunction:** hyposmia or anosmia was observed in 60% of patients, with partial recovery in some individuals over several months.
- **Sneezing episodes:** frequent in 40% of patients, often triggered by environmental irritants.

Symptom severity varied among patients and was frequently exacerbated by seasonal changes, air pollution, or temperature fluctuations.

Clinical examination revealed hyperemia of the nasal mucosa, mild edema of the inferior turbinates, and increased nasal secretions in the majority of patients. No acute infectious signs were detected at the time of examination, supporting the chronic nature of the post-COVID nasal pathology.

These findings suggest that post-COVID rhinitis presents with a combination of obstructive, secretory, and sensory symptoms, reflecting underlying inflammatory and structural alterations of the nasal mucosa.

Morphological Features. Histological examination of nasal mucosal biopsy specimens from patients with a history of COVID-19 revealed significant post-viral structural alterations consistent with chronic inflammatory remodeling.

Epithelial Changes

- Partial desquamation of the respiratory epithelium was observed in 75% of patients.
- Goblet cell hyperplasia and focal epithelial thickening were common, indicating compensatory responses to persistent mucosal irritation.
- Ciliary loss and degeneration of the epithelial surface were noted in 60% of cases, correlating with impaired mucociliary clearance.

Vascular and Connective Tissue Alterations

- Subepithelial vascular congestion and dilatation were observed in 70% of specimens.
- Focal edema of the lamina propria was present in 65% of patients.
- Mild proliferation of connective tissue and early fibrotic changes were identified in 30% of cases, suggesting early remodeling of nasal mucosal architecture.

Inflammatory Infiltration

- Predominantly lymphocytic infiltration was noted, with occasional neutrophils and macrophages.
- The degree of inflammatory cell infiltration correlated with the severity of clinical nasal symptoms, including obstruction and rhinorrhea.

Microcirculatory Findings

- Microvascular disturbances, including capillary dilation and occasional perivascular edema, were detected in 55% of samples.
- These changes may contribute to persistent congestion and suboptimal oxygenation of the nasal mucosa.

Overall, the observed morphological features indicate chronic post-viral injury characterized by epithelial disruption, goblet cell hyperplasia, vascular instability, subepithelial edema, and lymphocytic infiltration. These structural alterations provide a histopathological basis for the persistent clinical manifestations of rhinitis in post-COVID-19 patients.

Histopathological Interpretation Histopathological analysis of nasal mucosa in patients with a history of COVID-19 demonstrated characteristic post-viral alterations indicative of chronic inflammatory remodeling.

Epithelial Alterations. The respiratory epithelium exhibited partial degeneration, with frequent desquamation of epithelial cells and disruption of ciliary architecture. Goblet cell hyperplasia was consistently observed, reflecting a compensatory response to persistent mucosal irritation and impaired mucociliary clearance.

Vascular and Subepithelial Changes. Subepithelial vascular congestion, capillary dilatation, and mild edema were common findings. These microvascular disturbances may contribute to sustained nasal obstruction, tissue hypoxia, and prolonged symptomatology. In several cases, early fibrotic changes were detected within the lamina propria, suggesting initial stages of structural remodeling.

Inflammatory Response. The nasal mucosa demonstrated predominantly lymphocytic infiltration, with occasional neutrophils and macrophages. This chronic inflammatory profile correlates with ongoing clinical symptoms, including rhinorrhea, congestion, and hyposmia, even in the absence of active infection.

Functional Implications. Disruption of the epithelial barrier and loss of ciliary integrity likely impair mucociliary clearance, predisposing patients to secondary infections and prolonged nasal dysfunction. Vascular and connective tissue alterations may further exacerbate symptom persistence and contribute to chronic post-COVID rhinitis.

In summary, the histopathological findings support the concept of a distinct post-viral rhinitis phenotype in patients recovering from COVID-19, characterized by epithelial injury, vascular instability, subepithelial edema, and chronic inflammatory infiltration. Recognition of these features provides a foundation for targeted diagnostic evaluation and therapeutic intervention.

Discussion. The findings of this study demonstrate that rhinitis in patients with a history of COVID-19 is associated with persistent clinical symptoms and distinctive morphological alterations of the nasal mucosa. Clinically, the most frequent complaints were nasal obstruction, rhinorrhea, dryness, burning sensation, and olfactory dysfunction. These symptoms reflect both functional impairment and structural changes induced by post-viral inflammation.

Histological examination revealed epithelial desquamation, goblet cell hyperplasia, ciliary damage, subepithelial edema, vascular congestion, and lymphocytic infiltration. Such findings are indicative of chronic inflammatory remodeling following acute viral infection. The combination of epithelial injury and microvascular disturbances likely contributes to impaired mucociliary clearance, persistent congestion, and reduced olfactory function.

Our results are consistent with previous reports suggesting that COVID-19 may induce long-term upper airway pathology through direct viral cytopathic effects, immune-mediated tissue damage, and microvascular dysfunction. In comparison to typical post-viral rhinitis caused by other respiratory viruses, post-COVID rhinitis demonstrates a higher prevalence of vascular and epithelial remodeling, as well as prolonged symptom duration.

The correlation between the severity of histopathological changes and clinical symptoms underscores the importance of morphological assessment in the evaluation of persistent nasal

complaints. Identification of subepithelial edema, vascular congestion, and early fibrotic changes can guide targeted therapeutic interventions, including anti-inflammatory treatment and strategies to restore mucociliary function.

These findings highlight the need for continued monitoring of upper airway health in post-COVID patients and suggest that chronic rhinitis may represent a distinct post-viral complication requiring dedicated management strategies. Further studies are warranted to elucidate the long-term evolution of these histopathological changes and to optimize individualized treatment protocols.

Conclusion. Post-COVID rhinitis represents a persistent upper airway disorder characterized by both clinical and morphological alterations of the nasal mucosa. Patients commonly present with nasal obstruction, rhinorrhea, dryness, burning sensations, and olfactory dysfunction. Histopathological examination reveals epithelial desquamation, goblet cell hyperplasia, ciliary damage, subepithelial edema, vascular congestion, and lymphocytic infiltration, reflecting chronic inflammatory remodeling induced by previous COVID-19 infection.

The observed structural and functional changes provide a histopathological basis for the prolonged clinical manifestations and highlight the need for early diagnostic evaluation and targeted therapeutic strategies. Recognition of these post-viral features is essential for improving patient management, preventing chronic progression, and restoring optimal nasal function.

Future research should focus on longitudinal follow-up to assess the persistence of histopathological alterations and evaluate the efficacy of interventions aimed at reversing epithelial injury, reducing inflammation, and restoring mucociliary clearance in post-COVID patients.