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LITERATURE REVIEW

Rhinosinusal involvement in granulomatosis with polyangiitis – clinical insights

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ABSTRACT

BACKGROUND. Granulomatosis with polyangiitis (GPA) is a systemic necrotising vasculitis in which rhinosinusal disease is the most frequent and often earliest manifestation. Because sinonasal symptoms mimic chronic rhinosinusitis and other destructive midline disorders, timely diagnosis is frequently delayed.

MATERIAL AND METHODS. This review synthesizes current evidence on the clinical presentation, investigation, diagnosis, and management of rhinosinusal manifestations of GPA, with emphasis on endoscopic, radiologic, serologic, and histopathological findings. It also outlines ENT-specific approaches to local care and their integration with systemic immunosuppression.

RESULTS. Sinonasal involvement occurs in 70–90% of GPA cases, commonly preceding pulmonary or renal disease. Characteristic but non-specific endoscopic findings include crusting, ulceration, and necrosis, while imaging may demonstrate mucosal thickening and bony destruction. ANCA serology and biopsy support diagnosis but have limited sensitivity in localized disease, requiring multidisciplinary correlation. Management is centered on systemic immunosuppression (glucocorticoids with rituximab or cyclophosphamide), complemented by local measures such as saline irrigation, debridement, and topical corticosteroids. Surgery is reserved for complications or reconstructive purposes in remission.

CONCLUSION. Rhinosinusal disease is both a diagnostic entry point and a major determinant of morbidity in GPA. Early recognition, coordinated multidisciplinary evaluation, and balanced integration of systemic and local therapies are essential to reduce irreversible damage and improve long-term outcomes.

KEYWORDS: granulomatosis with polyangiitis, Wegener's granulomatosis, rhinosinusal disease, serology, biopsy, systemic immunosuppression.

INTRODUCTION

Granulomatosis with polyangiitis (GPA), previously referred to as Wegener's granulomatosis, is a systemic necrotising vasculitis classified among the antineutrophil cytoplasmic antibody (ANCA)–associated vasculitides (AAVs). It is typically defined by granulomatous inflammation of the respiratory tract and small- to medium-vessel vasculitis that may affect various organs. Clinically, GPA ranges from localised, airway-dominant disease to severe multisystem involvement with renal and pulmonary manifestations, emphasising the necessity for early identification and coordinated multidisciplinary care. Modern overviews highlight its diverse manifestations, the significance of PR3-ANCA (c-ANCA) serology (identification of autoantibodies directed against proteinase 3 (PR3), which can be found in neutrophil cytoplasm) in numerous patients, and the persistent morbidity despite therapeutic advancements[1,2].

From an epidemiological and clinical perspective, GPA is an infrequent autoimmune vasculitis, but it poses significant risks of organ damage and diminished quality of life if not promptly identified and managed. In routine clinical practice, the disease commonly presents with symptoms involving the upper aerodigestive tract, with otorhinolaryngologic symptoms often preceding lower respiratory or renal involvement. This pattern has led to a practical clinical model in which ENT specialists are essential for prompt case identification, tissue diagnosis, and referral to immunosuppressive therapy, thus changing the course of morbidity[1,3].

Rhinosinusal disease represents the classical head and neck way of manifestation of GPA. In cohort studies and narrative re-

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views, ENT involvement is predominantly reported, with sinonasal pathology representing the most common local manifestation. Depending on the setting and case definition, estimates range from 60% to 85%. In series with more airway-limited disease, the percentage may be even higher. The clinical spectrum includes persistent chronic rhinosinusitis, nasal obstruction, purulent discharge and crusting, epistaxis, ulceration, septal perforation, and late structural consequences like saddle-nose deformity and turbinate loss. These findings establish rhinosinusal disease as both a diagnostic entry point and a catalyst for enduring harm[4-6].

Pathobiologically, the upper airway mucosa in GPA is a site where granulomatous inflammation, small-vessel vasculitis, and tissue necrosis converge, resulting in the endoscopic and radiologic characteristics identified by otolaryngologists. During active disease, one might see inflammatory granulations, friable mucosa that bleeds easily on contact, adherent crusts, and necrotic plaques. Over time, repeated injury and healing cause cartilage loss and bony remodelling. Cross-sectional imaging shows the same changes, such as mucosal thickening, bony thickening, focal bone destruction, and, in advanced disease, extension towards the orbit or skull base. Understanding these stage-dependent patterns is essential for differentiating GPA from more prevalent inflammatory sinonasal disorders[4,7].

Diagnostic uncertainty is common because rhinosinusal GPA often mimics primary chronic rhinosinusitis, allergic or infectious etiologies, and even other destructive midline processes (e.g. cocaine-induced lesions or lymphoproliferative disorders). Accordingly, a structured approach integrates careful endoscopic assessment with imaging and targeted biopsy when feasible, interpreted alongside ANCA (antineutrophil cytoplasmic antibodies) serology. While classification criteria are not diagnostic algorithms, the 2022 American College of Rheumatology (ACR) / European Alliance of Associations for Rheumatology (EULAR) criteria codify the weight of upper airway findings, PR3-ANCA status, and histological features, reflecting the modern clinico-serological framework that informs case ascertainment in practice and research[2,5].

Because upper airway disease is so common and important for predicting outcomes, a focused synthesis on rhinosinusal manifestations is needed. This paper compiles current evidence regarding clinical presentation, investigative methods (endoscopy, imaging, serology, and histopathology), diagnostic alignment with existing criteria, and ENT-directed management approaches specific to mucosal and structural disease. By emphasising practical, specialty-specific insights, it seeks to facilitate earlier diagnosis, logical evaluation, and multidisciplinary treatment that may reduce irreversible sinonasal damage and improve patient-reported outcomes[3,4,7].

RHINOSINUSAL MANIFESTATIONS OF GPA

Granulomatosis with polyangiitis is a heterogeneous clinical condition. The symptoms range from general ones like fever, malaise, night sweats, weight loss, and arthralgia to more specific symptoms that show how the disease affects the blood vessels and granulomas. Pulmonary involvement often manifests as cough, haemoptysis, or dyspnoea due to nodules or alveolar haemorrhage, whereas renal disease typically presents with microscopic haematuria and proteinuria, progressing to glomerulonephritis. Cutaneous purpura, ocular inflammation, and peripheral neuropathy may also occur, stressing the systemic nature of the disorder. This variable symptomatology frequently leads to diagnostic delays, particularly when upper airway symptoms are evaluated separately from systemic indicators[1,2].

Within this broad clinical picture, rhinosinusal disease remains the most common and characteristic presentation of GPA. Sinonasal involvement is reported in 70–90% of cases and frequently serves as the initial indicator of the disorder, in most cases preceding pulmonary or renal disease by months or even years. The symptoms are often indistinguishable from chronic rhinosinusitis, with patients experiencing persistent nasal obstruction, purulent discharge, crusting, and recurrent epistaxis despite conventional therapy. Facial pain, hyposmia, and recurrent sinus infections may accompany these features. Over time, chronic inflammation and necrosis of the nasal septum may culminate in perforation and, in advanced disease, collapse of the cartilaginous dorsum, producing the classic saddle-nose deformity[4-6].

Endoscopic evaluation typically reveals friable mucosa with ulceration, adherent crusts, and areas of necrosis, while radiological studies demonstrate mucosal thickening, poor sinus aeration, and occasional osseous erosion. These findings are particularly concerning when they appear disproportionate to the symptoms or are refractory to standard medical treatment. Distinguishing GPA from more common inflammatory sinonasal conditions therefore requires a high index of suspicion, integration of systemic features, and careful correlation with serological and histopathological data[3,7].

DIAGNOSTIC METHODS

Endoscopic assessment

Nasal endoscopy is a frontline tool in evaluating suspected rhinosinusal involvement in GPA. Endoscopic inspection often reveals characteristic but non-specific findings such as erythematous and friable mucosa, adherent crusts, ulcerations, necrotic areas, and mucosal edema. In a dedicated study[8], narrow-band imaging (NBI) was applied to nasal mucosa in GPA and demonstrated increased vascular patterns compared to healthy mucosa, suggesting its potential role in highlighting abnormal inflammatory changes. Endoscopic visualization therefore remains indispensable not only for initial recognition but also for biopsy targeting and disease monitoring[8].

In a broader clinicopathological context, endoscopic findings in GPA may subtly differ from those in chronic rhinosinusitis: crusting and mucosal necrosis are more suggestive of vasculitic or granulomatous processes rather than purely allergic or infectious causes.

Careful photographic documentation and serial endoscopy may also help monitor response to therapy over time[9].

Imaging (CT/MRI)

Cross-sectional imaging complements endoscopy by defining mucosal disease, structural damage, and extension beyond the sinonasal cavity. A systematic review published in 2017 by D'Anza et al.[10] showed that mucosal thickening (87.7%), bony destruction (59.9%), and septal erosion (59.4%) are the most frequently reported CT findings in sinonasal GPA, while MRI refines soft-tissue characterization and identifies suspected orbital or skull base spread.

A more recent retrospective cohort analysis on 17 patients with GPA (published by Tateyama et al.[7] in 2024) confirmed that CT of the paranasal sinuses commonly illustrates mucosal and bony thickening (94.1% and 70.6%, respectively), with sections showing bone destruction (23.5%) and even orbital invasion masses (17.6%). The study also emphasized that imaging patterns vary with disease phase (active versus remission)[7].

In practice, disproportionate unilateral disease, osseous remodelling or destruction, and extra-sinonasal extension should heighten suspicion for GPA over routine chronic rhinosinusitis[7,10].

Serology (ANCA and related testing)

Serology supports, but does not replace, clinicopathological diagnosis. The 2017 international consensus on ANCA testing recommends high-quality antigen-specific immunoassays (PR3-ANCA and myeloperoxidase (MPO)-ANCA) as an appropriate primary screening method, without a categorical requirement for indirect immunofluorescence, reflecting improved assay performance. Results must still be interpreted in clinical context, as limited, ENT-predominant disease can be seronegative[11].

In suspected GPA with sinonasal-predominant features, a positive PR3-ANCA strengthens diagnostic probability, but negative testing should not stop further evaluation when endoscopic or imaging findings are convincing[11].

Histology / Biopsy

Biopsy remains the arbiter in equivocal cases, though yield varies by site. Classical features include geographic necrosis, granulomatous inflammation (with multinucleated giant cells), and pauci-immune small-vessel vasculitis; nonetheless, obtaining the full triad in upper airway biopsies is uncommon, and many samples show partial or non-specific changes (chronic inflammation, fibrosis), needing clinico-serologic correlation[12]. Evidence from non-renal biopsy series emphasize the variable sensitivity of sinonasal mucosa and the importance of sampling active margins of ulcers or granulation tissue to maximize diagnostic yield[12].

DIAGNOSTIC CHALLENGES

The diagnosis of granulomatosis with polyangiitis (GPA) is inherently complex due to the absence of a single definitive test. It relies on the meticulous integration of clinical presentation, laboratory findings, imaging, and histopathology, alongside the exclusion of conditions that may mimic GPA[13]. Patients frequently exhibit symptoms affecting various systems—ENT, pulmonary, renal, cutaneous, or neurological—that, when evaluated collectively, suggest the possibility of ANCA-associated vasculitis, especially in the presence of constitutional manifestations such as fever, weight loss, or arthralgia[14].

The 1990 American College of Rheumatology (ACR) classification criteria, although primarily intended for research, continue to exert influence in clinical reasoning; they encompass oral or nasal inflammation, abnormal chest radiography, abnormal urinary sediment, and granulomatous inflammation on biopsy[15,16]. The 2022 ACR/EULAR classification criteria introduced a weighted scoring system that includes ENT findings (e.g. nasal crusting, ulceration), PR3-ANCA positivity, and biopsy evidence of granulomatous inflammation, enhancing sensitivity and specificity for contemporary patient cohorts[2]. Classification tools assist in structured assessment; however, clinicians must exercise discernment, as numerous patients with limited ENT-predominant disease do not meet all criteria at presentation[17].

Even with these advances, there are still certain challenges with diagnosis. ANCA serology is highly specific but not very sensitive: up to 20% of individuals with localized disease do not have positive ANCA, especially in sinonasal-limited forms[18]. Conversely, false positives may occur in infectious or autoimmune diseases, meaning that serology cannot be interpreted in isolation[19]. Histopathology, often regarded as the gold standard, is similarly constrained: the diagnostic triad of granulomatous inflammation, necrosis, and vasculitis is seldom demonstrated in a single sinonasal biopsy, with numerous specimens exhibiting only nonspecific chronic inflammation[12]. Consequently, a negative biopsy cannot definitively exclude GPA, particularly when other clinical and radiological characteristics are persuasive.

Differential diagnosis makes things even more complicated. Cocaine-induced midline destructive lesions (CIMDL), extranodal NK/T-cell lymphoma, IgG4-related disease, and aggressive chronic rhinosinusitis may present similarly to GPA in endoscopic and radiographic evaluations[20]. In these situations, longitudinal observation, repeated biopsies, and multidisciplinary collaboration are frequently essential to establish the diagnosis.

Another limitation stems from the erroneous use of classification criteria as diagnostic criteria. The 2022 ACR/EULAR criteria enhance homogeneity in research; however, they do not replace actual diagnostic algorithms[2].

Finally, diagnostic delays are still common: many patients initially present to ENT clinics with only sinonasal symptoms, and in the absence of systemic symptoms, it may take longer to recognize the condition. This highlights the importance of increased awareness of this autoimmune entity among otolaryngologists[9].

ENT MANAGEMENT OF THE RHINOSINUSAL MANIFESTATIONS

Overall strategy and goals

Management of sinonasal disease in granulomatosis with polyangiitis (GPA) is multidisciplinary and layered: (i) local ENT care to control mucosal inflammation, crusting, secondary infection, and to maintain patency; (ii) systemic immunosuppression to induce and maintain remission of the underlying

vasculitis; and (iii) selective surgery for complications (obstruction, refractory sepsis), sequelae (septal perforation, saddle-nose) or diagnostic purposes. Contemporary reviews from rheumatology and ENT emphasize that local measures are supportive and cannot substitute for systemic disease control, which relies on guideline-directed immunosuppression[4,21].

Local/rhinologic measures

For active sinonasal disease, saline irrigations, meticulous crust debridement, and topical intranasal corticosteroids are routinely used to reduce mucosal edema, discharge and bleeding. Short courses of culture-directed antibiotics treat secondary bacterial infection. ENT reviews specific to GPA recommend a conservative, stepwise local regimen, while reminding clinicians that persistent necrotic crusting or ulceration should prompt reassessment of systemic control[4,17].

Systemic induction therapy (vasculitis control)

For organ-threatening or severe ANCA-associated vasculitis (including GPA with significant airway disease), glucocorticoids plus rituximab or cyclophosphamide are recommended for remission induction.

The RAVE trial (rituximab versus cyclophosphamide for ANCA-Associated Vasculitis), which enrolled 197 ANCA-positive patients with Wegener's granulomatosis/microscopic polyangiitis, showed that rituximab is non-inferior to daily cyclophosphamide for induction and may be superior in relapsing disease, supporting its widespread use[22]. The RITUXVAS trial (rituximab versus cyclophosphamide in ANCA-Associated Renal Vasculitis) found similar efficacy versus intravenous cyclophosphamide regimens[23].

The PEXIVAS trial (Plasma Exchange and Glucocorticoids for Treatment of ANCA-Associated Vasculitis) supports reduced-dose glucocorticoids and showed no overall benefit of plasma exchange for most patients with severe AAV[24]. The randomized control trial, performed between 2010 and 2016 on 704 patients (95 centres, 16 countries) diagnosed with GPA or microscopic polyangiitis, compared the efficacy of plasma exchange therapy with no plasma exchange plus cyclophosphamide or rituximab, and standard-dose oral glucocorticoid regimens versus reduced-dose oral glucocorticoid regimens.

The 2022 EULAR update integrates these data and notes that avacopan (an oral C5a-receptor inhibitor) may be considered with rituximab/cyclophosphamide to reduce steroid exposure, based on the ADVOCATE trial (avacopan for the treatment of ANCA-Associated Vasculitis). In that trial, patients treated with avacopan achieved remission at week 26 (primary endpoint) in 72.3% of cases and at week 52 (second endpoint) in 65.7%, while in patients receiving prednisolone, remission was 70.1% at week 26 and 54.9% at week 52. Avacopan proved non-inferior remission at week 26 ($p<0.001$ for noninferiority, $p=0.24$ for superiority) and superior sustained remission at week 52 versus prednisone taper ($p<0.001$ for noninferiority, $p=0.007$ for superiority)[25,26].

Systemic maintenance therapy

After induction, rituximab maintenance prevents relapse more effectively than azathioprine (MAINRITSAN – Maintenance of Remission using rituximab in ANCA-Associated Vasculitis), and is recommended by EULAR as first-line maintenance in GPA/MPA. Alternatives include azathioprine or methotrexate when rituximab is unsuitable. Duration is typically 18–24 months, or longer if individualized according to relapse risk[24,27].

Role of endoscopic sinus surgery (ESS)

ESS is not a substitute for immunosuppression, but can be considered for selected problems – obstructive disease with recirculation, persistent focal sepsis despite optimized medical care, drainage and culture of closed cavities, and to obtain diagnostic tissue. ENT reviews advise reserving surgery for quiescent or medically optimized disease to reduce wound-healing complications. Outcomes depend on systemic control and meticulous postoperative care (irrigation, debridement, topical steroids)[4,21].

Reconstruction of septal perforation and saddle-nose deformity

Structural reconstruction is generally postponed until stable remission. Systematic and cohort reports indicate that external rhinoplasty with strong cartilage grafting (often costal) can improve function and appearance, with acceptable complication rates when disease is silent. Historical series and recent reviews both stress timing (operate in remission) and robust grafting strategies[28,29].

Follow-up and multidisciplinary care

ENT follow-up with serial endoscopy documents mucosal healing, detects relapse (new ulceration, bleeding, crusting), and guides debridement and topical therapy adjustments. Close collaboration with rheumatology aligns local findings with systemic disease activity and informs immunosuppression tapering or escalation. Reviews highlight that proactive ENT surveillance can reduce cumulative sinonasal damage when integrated with modern vasculitis protocols[4,21].

A correct diagnosis, treatment and follow-up of patients with granulomatosis with polyangiitis are very important. The literature reports an overall mortality rate 2.6 times higher in patients with GPA than in the general population[30]. The 10-year survival rate in GPA patients is reported to be around 40% if renal involvement is present, and 60–70% in patients without renal involvement[31]. With the introduction of immunosuppressive treatment, the 5-year survival rate increased up to 80%[32].

OUR EXPERIENCE

A 50-year-old woman presented to our ENT Department with a long-standing history of nasal obstruction, recurrent epistaxis, purulent discharge, and facial pain, which had persisted for several years despite multiple courses of antibiotics and topical corticosteroids. The symptoms gradually progressed to persistent crusting, fetid nasal secretions, and septal perforation, accom-

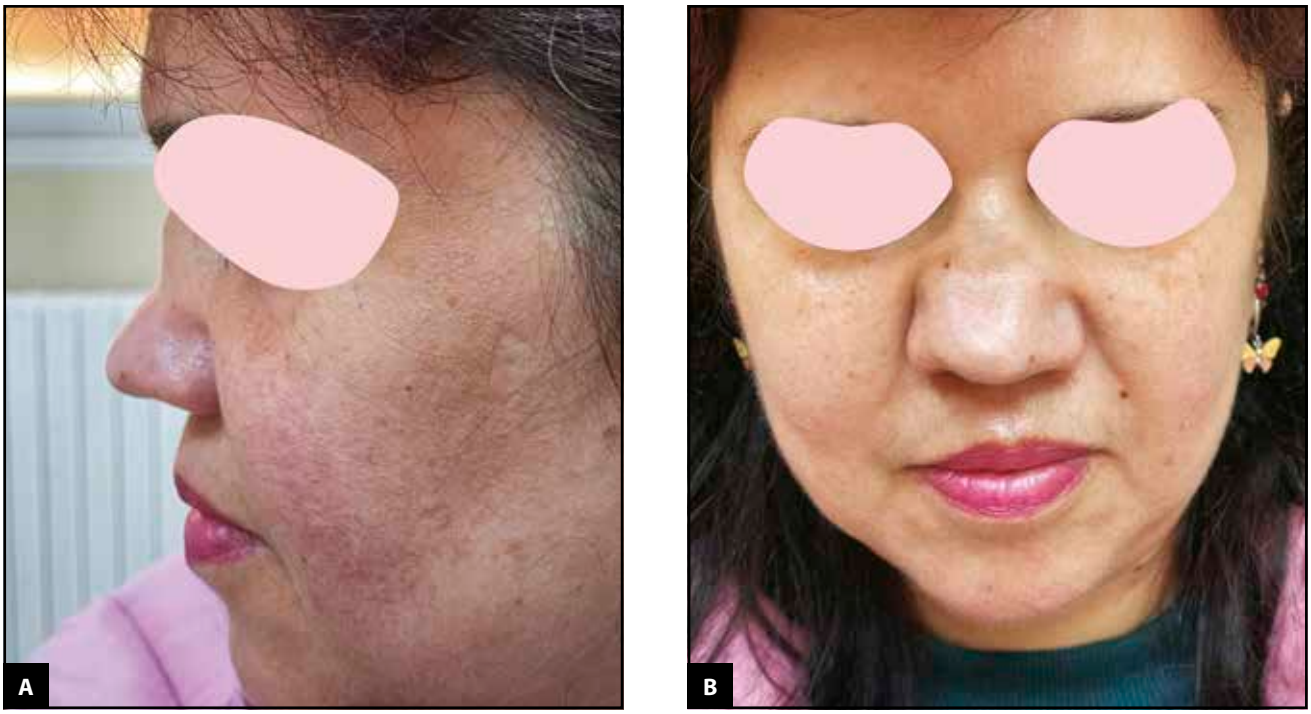

Figure 1. Saddle-nose deformity.

panied by intermittent aural fullness and hearing loss.

Nasal endoscopy revealed friable mucosa with extensive crusting over the nasal septum and inferior turbinates, an anterior septal perforation, and areas of necrotic mucosa extending toward the middle meatus. The nasal bridge appeared mildly collapsed, suggesting early saddle-nose deformity (Figure 1).

Computed tomography of the paranasal sinuses demonstrated diffuse opacification of the ethmoidal and maxillary sinuses, bony erosions of the nasal septum, and obliteration of the ostiomeatal complexes, consistent with granulomatous destructive rhinosinusitis. Audiological assessment identified bilateral mixed hearing loss, and otoscopic examination revealed thickened, retracted tympanic membranes with evidence of chronic otitis media.

A targeted endoscopic nasal biopsy taken from the margin of the septal perforation showed necrotizing granulomatous inflammation with small-vessel vasculitis, confirming the diagnosis of granulomatosis with polyangiitis (GPA). Following this, the patient underwent bilateral functional endoscopic sinus surgery (FESS) to remove obstructive granulomatous tissue and to restore sinus ventilation and drainage. Postoperative care included regular saline irrigations, topical corticosteroid sprays, and scheduled endoscopic debridement to prevent crust accumulation and synechiae formation.

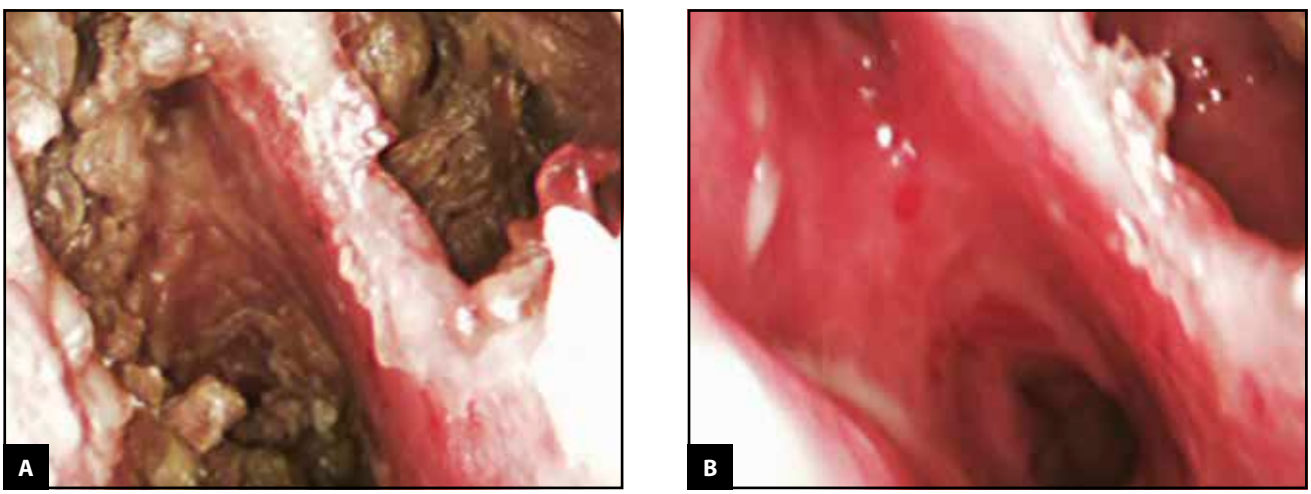

Figure 2. Endoscopic appearance of the nasal cavity before and after removal of extensive crusting.

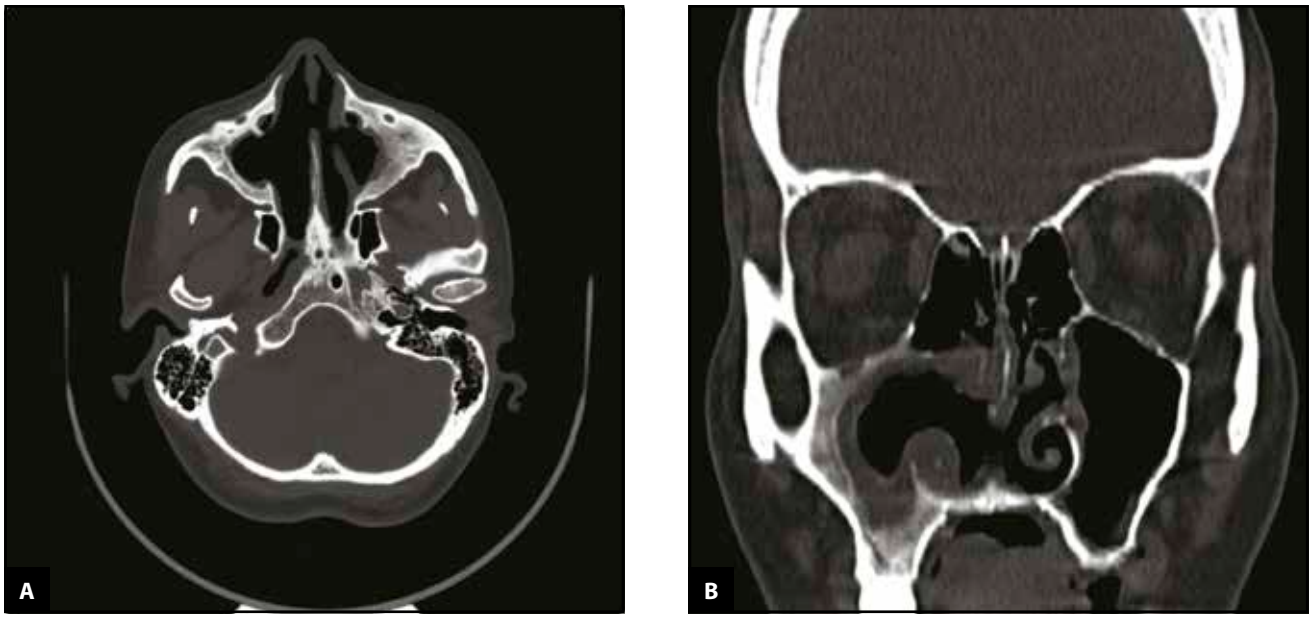

Figure 3. Postoperative follow-up CT scan of the nose and paranasal sinuses, axial and coronal slices, reveals bony erosions of the nasal septum, thickened and nodular mucosa.

During follow-up, despite adequate systemic control achieved with rituximab and low-dose glucocorticoids, she experienced periodic exacerbations of nasal crusting and purulent otorrhea associated with *Staphylococcus aureus* colonization, which required culture-guided antibiotic therapy and intensified local care. Over the years, meticulous nasal hygiene and early ENT intervention successfully limited progressive tissue destruction, though the septal perforation remained stable (Figure 2, Figure 3).

The case illustrates how rhinosinusal disease often dominates the clinical course of GPA, posing persistent local challenges even during systemic remission. It emphasizes the need for coordinated ENT follow-up, repeated endoscopic surveillance, and early surgical intervention when conservative management fails, to preserve structure and function within the upper airways.

CONCLUSIONS

Rhinosinusal involvement remains a central and defining feature of granulomatosis with polyangiitis, yet it continues to pose diagnostic and therapeutic challenges. This review underscores that sinonasal symptoms are often the earliest clinical sign, but their overlap with chronic rhinosinusitis and other midline-destructive conditions frequently delays recognition. Despite advances in ANCA testing and updated classification criteria, both serology and histopathology have important limitations, particularly in localized disease. This reaffirms the need for a multimodal approach combining careful endoscopic evaluation, cross-sectional imaging, and targeted biopsy, interpreted in multidisciplinary collaboration.

Management strategies further highlight the duality of care: while systemic immunosuppression remains the cornerstone for achieving remission and preventing systemic complications, local ENT-directed interventions are essential for reducing sinonasal morbidity, preventing irreversible structural damage, and improving quality of life. The persistence of long-term sequelae, such as septal perforation and saddle-nose deformity, demonstrates that timely recognition and coordinated treatment remain critical.

Ultimately, the ENT specialist's role is pivotal, both in early case identification and ongoing follow-up, making rhinosinusal GPA a paradigm of how specialty-specific vigilance can influence outcomes in systemic autoimmune disease.

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REFERENCES

1. Rout P, Garlapati P, Qurie A. Granulomatosis with polyangiitis. StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Available from: https://www.ncbi.nlm.nih.gov/books/NBK557827/.
2. Robson JC, Grayson PC, Ponte C, Suppiah R, Craven A, et al. 2022 American College of Rheumatology/European Alliance of Associations for Rheumatology classification criteria for granulomatosis with polyangiitis. Ann Rheum Dis. 2022;81(3):315-20. DOI: 10.1136/annrheumdis-2021-221795.
3. Webb H, Toppi J, Fairley J, Phillips D. Granulomatosis with polyangiitis: a rare but clinically important disease for the otolaryngologist. Niger J Clin Pract. 2024;27(7):819-26. DOI: 10.4103/njcp.njcp_790_23.
4. Coates ML, Willcocks LC, Sivasothy P, Del Pero MM. Ear, nose, throat and airways disease in granulomatosis with polyangiitis. Rheumatology (Oxford). 2021;60(Supple 3):iii50-iii53. DOI: 10.1093/rheumatology/keab042.
5. Padoan R, Campaniello D, Felicetti M, Cazzador D, Schiavon F. Ear, nose, and throat in ANCA-associated vasculitis: a comprehensive review. Vessel Plus. 2021;5:41. DOI: 10.20517/2574-1209.2021.41.
6. Felicetti M, Cazzador D, Padoan R, Pendolino AL, Faccioli C, Nardello E, et al. Ear, nose and throat involvement in granulomatosis with polyangiitis: how it presents and how it determines disease severity and long-term outcomes. Clin Rheumatol. 2018;37(4):1075-83. DOI: 10.1007/s10067-018-4019-0.
7. Tateyama K, Umemoto S, Iwano S, Hirano T, Suzuki M. Sinonasal manifestations of granulomatosis with polyangiitis: A retrospective analysis. Auris Nasus Larynx. 2024;51(4):625-30. DOI: 10.1016/j.anl.2024.04.002.
8. Trimarchi M, Bozzolo E, Pilolli F, Bertazzoni G, Campochiaro C, Sabbadini MG, et al. Nasal mucosa narrow band imaging in granulomatosis with polyangiitis (Wegener granulomatosis): A preliminary study. Am J Rhinol Allergy. 2015;29(3):170-4. DOI: 10.2500/ajra.2015.29.4169.
9. Hegazy MT, Ahmed H, Eltelety AM. ENT manifestations of Granulomatosis with polyangiitis. Vessel Plus. 2021;5:46. DOI: 10.20517/2574-1209.2021.52.
10. D'Anza B, Langford CA, Sindwani R. Sinonasal imaging findings in granulomatosis with polyangiitis (Wegener granulomatosis): A systematic review. Am J Rhinol Allergy. 2017;31(1):16-21. DOI: 10.2500/ajra.2017.31.4408.
11. Bossuyt X, Tervaert JWC, Arimura Y, Blockmans D, Flores-Suarez LF, Guillevin L, et al. Position paper: Revised 2017 international consensus on testing of ANCAs in granulomatosis with polyangiitis and microscopic polyangiitis. Nat Rev Rheumatol. 2017;13(11):683-92. DOI: 10.1038/nrrheum.2017.140.
12. Masiak A, Zdrojewski Z, Peksa R, Smolenska Z, Czuszynska Z, Sieminska A, et al. The usefulness of histopathological examinations of non-renal biopsies in the diagnosis of granulomatosis with polyangiitis. Rheumatologia. 2017;55(5):230-6. DOI: 10.5114/reum.2017.71638.
13. Jennette JC, Falk RJ, Bacon PA, Basu N, Cid MC, Ferrario F, et al. 2012 revised International Chapel Hill Consensus Conference Nomenclature of Vasculitides. Arthritis Rheum. 2013;65(1):1-11. DOI: 10.1002/art.37715.
14. Hoffman GS, Kerr GS, Leavitt RY, Hallahan CW, Leobovics RS, Travis WD, et al. Wegener granulomatosis: an analysis of 158 patients. Ann Intern Med. 1992;116(6):488-98. DOI: 10.7326/0003-4819-116-6-488.
15. Leavitt RY, Fauci AS, Bloch DA, Michel BA, Hunder GG, Arend WP, et al. The American College of Rheumatology 1990 criteria for the classification of Wegener's granulomatosis. Arthritis Rheum. 1990;33(8):1101-7. DOI: 10.1002/art.1780330807.
16. Watts R, Lane S, Hanslik T, Hauser T, Hellmich B, Koldingsnes W, et al. Development and validation of a consensus methodology for the classification of the ANCA-associated vasculitides and polyarteritis nodosa for epidemiological studies. Ann Rheum Dis. 2007;66(2):222–7. DOI: 10.1136/ard.2006.054593.
17. Holle JU, Laudien M, Gross WL. Clinical manifestations and treatment of Wegener's granulomatosis. Rheum Dis Clin North Am. 2010;36(3):507-26. DOI: 10.1016/j.rdc.2010.05.008.
18. McCarthy E, Mustafa M, Watts M. ANCA-negative granulomatosis with polyangiitis: a difficult diagnosis. Eur J Case Rep Intern Med. 2017;4(8):000625. DOI: 10.12890/2017_000625.
19. Savige J, Pollock W, Trevisin M. What do antineutrophil cytoplasmic antibodies (ANCA) tell us? Best Pract Res Clin Rheumatol. 2005;19(2):263-76. DOI: 10.1016/j.berh.2004.10.003.
20. Trimarchi M, Bondi S, Della Torre E, Terreni MR, Bussi M. Palate perforation differentiates cocaine-induced midline destructive lesions from granulomatosis with polyangiitis. Acta Otorhinolaryngol Ital. 2017;37(4):281-5. DOI: 10.14639/0392-100X-1586.
21. Hellmich B, Sanchez-Alamo B, Schirmer JH, Berti A, Blockmans D, Cid MC, et al. EULAR recommendations for the management of ANCA-associated vasculitis: 2022 update. Ann Rheum Dis. 2024;83(1):30-47. DOI: 10.1136/ard-2022-223764.
22. Stone JH, Merkel PA, Spiera R, Seo P, Langford CA, Hoffman GS, et al. Rituximab versus cyclophosphamide for ANCA-associated vasculitis. N Engl J Med. 2010;363(3):221-32. DOI: 10.1056.NEJMoa0909905.
23. Jones RB, Tervaert JWC, Hauser T, Luqmani R, Morgan MD, Peh CA, et al. Rituximab versus cyclophosphamide in ANCA-associated renal vasculitis. N Engl J Med. 2010;363(3):211-20. DOI: 10.1056/NEJMoa0909169.
24. Walsh M, Merkel PA, Peh CA, Szpirt WM, Peuchal X, Fujimoto S, et al. Plasma exchange and glucocorticoids in severe ANCA-associated vasculitis. N Engl J Med. 2020;382(7):622-31. DOI: 10.1056/NEJMoa1803537.
25. Jayne DRW, Merkel PA, Schall TJ, Bekker P; ADVOCATE Study Group. Avacopan for the treatment of ANCA-associated vasculitis. N Engl J Med. 2021;384(7):599-609. DOI: 10.1056/NEJMoa2023386.
26. Schirmer JH, Sanchez-Alamo B, Hellmich B, Jayne D, Monti S, Luqmani RA, et al. Systematic literature review informing the 2022 update of the EULAR recommendations for the management of ANCA-associated vasculitis (AAV): part 1—treatment of granulomatosis with polyangiitis and microscopic polyangiitis. RMD Open. 2023;9:e003082. DOI: 10.1136/rmdopen-2023-003082.
27. Guillevin L, Pagnoux C, Karras A, Khouatra C, Aumaitre O, Cohen P, et al. Rituximab versus azathioprine for maintenance in ANCA-associated vasculitis. N Engl J Med. 2014;371(19):1771-80. DOI: 10.1056/NEJMoa1404231.
28. Coordes A, Loose SM, Hofmann VM, Hamilton GS 3rd, Riedel F, Menger DJ, et al. Saddle nose deformity and septal perforation in granulomatosis with polyangiitis. Clin Otolaryngol. 2018;43(1):291-9. DOI: 10.1111/coa.12977.
29. Gantous A, Fernandez-Pellon Garcia RF. Nasal reconstruction in granulomatosis with polyangiitis: a two decade review. Facial Plast Surg Aesthet Med. 2023;25(1):61-7. DOI: 10.1089/fpsam.2021.0348.
30. King C, Harper L, Little M. The complications of vasculitis and its treatment. Best Pract Res Clin Rheumatol. 2018;32(1):125-36. DOI: 10.1016/j.berh.2018.07.009.
31. Greco A, Marinelli C, Fusconi M, Macri GF, Gallo A, De Virgilio A, et al. Clinic manifestations in granulomatosis with polyangiitis. Int J Immunopathol Pharmacol. 2016;29(2):151-9. DOI: 10.1177/0394632015617063.
32. Emejuaiwe N. Treatment strategies in ANCA-associated vasculitis. Curr Rheumatol Rep. 2019;21(7):33. DOI: 10.1007/s11926-019-0835-8.