

Chapter 25

Asymptomatic Isolated Ethmoid Sinusitis as Potential Etiological Nidus for Recurrent Acute Rhinosinusitis - A Radiological Perspective

Niranjan Sahu^{1*}

¹Professor, Department of Radiodiagnosis, Institute of Medical Sciences and SUM Hospital, Siksha O Anusandhan Deemed to be University, Bhubaneswar-751003, Odisha, India.

*Corresponding Author.

Abstract

Recurrent acute rhinosinusitis (RARS), a mild form of chronic rhinosinusitis, often goes undiagnosed owing to insufficient understanding of its clinical manifestations. The objective of the research is to assess the implications of ethmoid sinusitis in individuals with RARS during symptom-free periods between the acute rhinosinusitis episodes. Imaging can be utilised for surgical planning in cases of recurrent or chronic sinus infections. The author reviews the role of asymptomatic isolated ethmoid sinusitis as a potential etiological nidus for future RARS.

Keywords: Isolated Ethmoid Sinusitis, Sinonasal CT, Recurrent Acute Rhinosinusitis.

Introduction

A condition related to mucosal inflammation of nasal and paranasal sinuses, known as rhinosinusitis (RS), is categorised as acute rhinosinusitis (ARS) when symptoms persist for < 4 weeks and chronic rhinosinusitis (CRS) when symptoms persist for > 12 weeks [1]. When the symptoms of ARS do not resolve within 10 days of symptom onset, or when symptoms of ARS worsen within 10 days after an initial improvement (called double worsening), the condition is diagnosed as acute bacterial rhinosinusitis (ABRS). The signs and symptoms of ABRS occurring at least 4 times within a year, with no symptoms persisting between episodes, constitute the diagnostic criteria for the disease, called as recurrent ARS (RARS) [2]. During the asymptomatic interval between two bouts of ABRS, most RARS patients showed mild signs of isolated ethmoid sinusitis on brain computed tomography (CT) scans obtained for indications unrelated to sinonasal symptoms. Furthermore, ethmoid sinus infection is the initial stage in most cases of ABRS. Ethmoid sinus involvement is essential for the development of recurrent frontal and maxillary sinusitis, according to research on the pathophysiology of rhinosinusitis [3].

During radiological evaluations for other purposes, simple ethmoid sinus infections are typically identified retrospectively. The fatality rate from meningitis caused by sinus infections was approximately 17% before the advent of antibiotics, but is now between 1% and 2.5% in the era of high-generation antibiotics [4]. Due to antibiotic use, mild sinus infections are often suppressed before they present with typical signs and symptoms. The main cause of the inadequate delineation of ethmoiditis in a standard sinus radiograph is the superimposition of different ethmoid cells. When it comes to identifying sinus pathology in the sphenoid and ethmoid sinuses, a CT scan of paranasal sinuses is more sensitive than plain radiography and offers better clarity of the sinuses.

CT scans are primarily used to assess sinus anatomy before surgery and to help diagnose different forms of sinusitis. The condition of the bone walls and intrasinus materials can be assessed using CT imaging. An efficient and thorough examination of the ethmoid labyrinth is made possible by axial CT scans [5]. The purpose is to ascertain the prevalence and importance of asymptomatic isolated mild degree ethmoid sinusitis contributing to the recurrent nature of the RARS disease.

Etiology

The predominant factors contributing to RARS are akin to those associated with other types of sinusitis. The predominant origin of sinusitis is a viral infection, typically affecting the upper respiratory tract, which resolves spontaneously [6]. In these scenarios, viral infection activates inflammation and irritation of the sinonasal mucosal lining. This inflammation constricts the sinus ostia, hindering the removal of the sinonasal bacteria, airborne particles and mucus from the sinus cavities. Inflammation-induced disruption of ciliary activity leads to mucus retention and increases the sinuses' susceptibility to bacterial infections. If left untreated, allergic rhinitis can result in chronic nasal and paranasal sinus irritation, leading to outflow tract obstruction, accumulation of secretions, and possible bacterial infection.

The prevalent bacterial pathogens responsible for RARS include *Streptococcus pneumoniae*, *Moraxella catarrhalis*, *Haemophilus influenzae*, *Staphylococcus aureus* and various *Streptococcus* species [7]. *Staphylococcus aureus* frequently inhabits the nasal passages and contributes to recurrent infection, particularly in those who have received numerous antibiotic treatments. There exists a degree of etiological similarity between RARS and CRS. Non-invasive fungal infections, including those caused by *Aspergillus fumigatus*, can be identified in these individuals. Sinonasal anatomical variants that cause osteo-meatal unit obstruction, such as conchae bullosae, turbinate hypertrophy, Haller cells (pneumatized medial orbital floor), nasal polyps, nasal masses, septal deviations and spurs, and narrowed sinus ostia, may render the paranasal sinuses and nasal cavity susceptible to infection [8,9]. These anatomical variants are frequently amendable by endoscopic sinus surgery. Deviated nasal septum is associated with inferior turbinate hypertrophy, supporting the decision for inferior turbinate excision at the time of nasal septoplasty [10].

Genetic influences on sinonasal mucus secretion and nasociliary movement are exemplified by Kartagener syndrome and have contributed to the pathogenesis of sinus disorders. Environmental elements, including prolonged exposure to inhaled irritants and tobacco smoke, are associated with the onset and/or worsening of the RARS disease. These elements hinder ciliary motility, disrupting cellular communication within the innate immune system and worsening the situation [11].

Pathophysiology

The etiology of the ARS probably entails the impairment of the sinus ostia and the ciliary system. Upper respiratory tract allergens and viral infections induce mucosal swelling, which constricts the sinus openings and results in direct mechanical blockage. Sinonasal obstruction can result in the buildup of thick secretions, creating a favorable environment for fungal and bacterial proliferation. Sinus outflow obstruction can alter sinus pressure when oxygen is absorbed by the sinus mucosa, creating a partial vacuum. Altered sinus pressure may cause discomfort and lead to increased fluid effusion into the sinus. This excess fluid, along with inflammation and the presence of neutrophils and lymphocytes, may ultimately generate positive pressure, resulting in patient discomfort. In most cases of chronic sinusitis, negative pressure may persist to the point of inducing volume loss of the maxillary sinuses, a condition known as silent sinus syndrome. The resulting effect causes orbital floor dehiscence and enophthalmos [12].

Modified sinonasal secretions intensify vulnerability to chronic sinus infection. Typically, the intrasinus mucous layer comprises two separate strata: the periciliary liquid phase is a slender, low-viscosity layer encasing the cilia shaft that facilitates unobstructed ciliary motion, and the gel phase is a thicker layer positioned above the periciliary liquid. Inflammation can alter the separation between the two mucous layers, which may hinder ciliary motion by disrupting the typical low-viscosity milieu [13]. Furthermore, bacterial biofilms can contribute to the etiology of sinus infection, though they are more common in CRS than in RARS. Biofilms impede antibiotic penetration because the bacteria within this structure are securely bound to one another and to the surface, and are enveloped by a defensive protein or polysaccharide matrix [14]. *Staphylococcus aureus* is particularly adept at forming biofilms, which require chemical and potentially mechanical interventions to completely eradicate the infection.

Discussion

Compared to regular CRS, RARS is a milder form of CRS. Furthermore, RARS may have been underdiagnosed because it was not recognised as a distinct type of CRS [15]. Most RARS cases that had undergone a brain CT study for reasons other than nasal and paranasal sinus-related symptoms showed features of isolated ethmoid sinus infection, which often go undetected due to the lack of symptoms and are a potential nidus of bacterial infection during the asymptomatic interval [4]. Several studies identifying the cause of recurrent maxillary or frontal sinusitis have found that the ethmoid sinus plays a significant role [5]. Despite a sporadic diagnosis, this could be considered a criterion for determining the prevalence of RARS.

Therefore, determining whether the ethmoid sinus is involved in recurrent sinusitis requires a rigorous radiologic investigation. Because of the radiographic superimposition view of ethmoid cells on either side, the ethmoid labyrinth is less well defined in comparison to other paranasal sinus groups. A cluster of opacified cells may also be concealed by nearby normal cells of low air density. Conversely, the axial CT sections clearly show the ethmoid labyrinth. Accurate evaluation of extremely subtle ethmoid abnormalities is aided by thin-collimation CT slices. Because of the effective delineation of the osteomeatal unit, coronal CT images are indicated for preoperative evaluation of sinus surgery [5]. CT scans of asymptomatic patients often show intrasinus soft-tissue attenuations, which may indicate scarring or a persistent inflammatory condition.

The incidence of this ethmoid sinus abnormality in an asymptomatic patient should be identified at the appropriate time for both conservative and targeted surgical treatments. According to a study, young adolescents frequently get sinonasal infections without exhibiting any signs of sinusitis. This can be attributed to children's frequent upper respiratory tract infections, as well as other factors, such as redundant mucosa in the sinonasal structures and copious tear production from frequent crying [16]. Asthma, ciliary dyskinesia, cystic fibrosis, and immunocompromised states are among the chronic illnesses that should be appropriately evaluated in patients with RARS because these conditions typically alter the course of treatment. Even for a few disorders that require therapy separate from RARS, understanding associated comorbid conditions also enhances their care. By detecting and treating allergens that frequently occur in RARS, you can improve your patients' quality of life, even when overlapping symptoms make the diagnosis challenging. Despite RARS's high frequency and significant economic impact, there is considerable practice variation both within and between the several disciplines involved in its management [17].

CT scans are often used for diagnosis, to determine the extent of disease, and to pinpoint the sinonasal structures affected. Since RARS

is a scaled-down version of the conventional CRS, combining CT results with the overall severity of the patient's illness is always the best method for clinicians to grade the patient's condition more accurately [18]. Despite a high prevalence and significant illness persistence, diagnostic modalities such as sinonasal CT are underutilised to diagnose RARS, which frequently results in the disease being under-evaluated [4]. Sinonasal CT can guide surgeons performing skull base procedures and endoscopic sinus surgeries [19]. Ethmoid sinus disease can also be evaluated with MR imaging; however, it has reduced sensitivity for identifying fibrosis, as both T1- and T2-weighted images show low signal intensity. Both CRS and RARS should be identified from a single ARS episode, thereby raising awareness of these distinct clinical entities and enabling the implementation of favourable therapeutic options [20].

Conclusion

Adult patients with RARS frequently have asymptomatic, isolated ethmoid sinus infections detected on CT scans between acute rhinosinusitis episodes. The disease process was most frequently localised to a few ethmoid cells on either side. No discernible predominance was found by age or gender. Due to limited knowledge of the disease's pattern, diagnostic approaches are probably underutilised, which means the disease accounts for a comparatively small proportion of CRS. This chapter could help identify the best, most timely RARS diagnostic solution.

References

- [1] Rosenfeld RM, Piccirillo JF, Chandrasekhar SS, Brook I, Kumar KA, Kramper M, et al. Clinical Practice Guideline (Update): Adult Sinusitis Executive Summary. *Otolaryngology– Head and Neck Surgery*. 2015; 152(4):598-609.
- [2] Bhattacharyya N, Lee KH. Chronic recurrent rhinosinusitis: disease severity and clinical characterization. *Laryngoscope*. 2005; 115:306-310.
- [3] Eichel B. Ethmoiditis: pathophysiology and medical management. *Otolaryngol Clin North Am*. 1985; 18:43-53.
- [4] Fokkens WJ, Lund VJ, Mullol J, Bachert C, Alobid I, Baroody F, et al. European position paper on rhinosinusitis 4 and nasal polyps 2012. *Rhinology Suppl*. 2012; 23:1-298.
- [5] Sahu N, Mohapatra SS, Rath SN, Padhy RN. Radiological significance of isolated Ethmoid sinus infections in asymptomatic patients of recurrent acute rhinosinusitis. *Int J Res Med Sci*. 2017; 5(5):1781-1784.
- [6] DeMuri G, Wald ER. Acute bacterial sinusitis in children. *Pediatr Rev*. 2013; 34(10):429-437
- [7] Lacroix JS, Ricchetti A, Lew D, Delhumeau C, Morabia A, Stalder H, Terrier F, Kaiser L. Symptoms and clinical and radiological signs predicting the presence of pathogenic bacteria in acute rhinosinusitis. *Acta Otolaryngol*. 2002; 122(2):192-196.
- [8] Sahu N, Mohapatra SS, Rath SN, Padhy RN. Radiological significance of the sinonasal anatomical variants in recurrent acute rhinosinusitis patients. *International Journal of Research in Medical Sciences*. 2017; 5(6):2379-2384.
- [9] Van den Broek MF, Gudden C, Kluijfhout WP, Stam-Slob MC, Aarts MC, Kaper NM, van der Heijden GJ. No evidence for distinguishing bacterial from viral acute rhinosinusitis using symptom duration and purulent rhinorrhea: a systematic review of the evidence base. *Otolaryngol Head Neck Surg*. 2014; 150(4):533-537.
- [10] Sahu N, Mohapatra SS, Rath SN, Padhy RN. Computed tomographic evaluation of inferior turbinate hypertrophy in adult Indo-Dravidian patients with deviated nasal septum. *Asian J Pharm Clin Res*. 2017; 10(7):342-344.
- [11] Bhattacharyya N, Fried MP. The accuracy of computed tomography in the diagnosis of chronic rhinosinusitis. *Laryngoscope*. 2003; 113(1):125-129.
- [12] Henry DC, Riffer E, Sokol WN, Chaudry NI, Swanson RN. Randomized double-blind study comparing 3- and 6-day regimens of azithromycin with a 10-day amoxicillin-clavulanate regimen for treatment of acute bacterial sinusitis. *Antimicrob Agents Chemother*. 2003; 47(9):2770-2774
- [13] Luterman M, Tellier G, Lasko B, Leroy B. Efficacy and tolerability of telithromycin for 5 or 10 days vs amoxicillin/clavulanic acid for 10 days in acute maxillary sinusitis. *Ear Nose Throat J*. 2003; 82(8):576-80, 82-84
- [14] DelGaudio JM, Evans SH, Sobol SE, Parikh SL. Intracranial complications of sinusitis: what is the role of endoscopic sinus surgery in the acute setting. *Am J Otolaryngol*. 2010; 31(1):25-28
- [15] Bhattacharyya N, Grebner J, Martinson N G. Recurrent Acute Rhinosinusitis: Epidemiology and Health Care Cost Burden. *Otolaryngology – Head and Neck Surgery*. 2012; 146(2):307-312.
- [16] Talwade P, Deshpande PS, Pene S, Kumar S, Kudagi V, Limaye M. Incidental Paranasal Sinus Findings on Computed Tomography Images of Pediatric Patients: A Cross-sectional Prevalence Study. *Int J Clin Pediatr Dent*. 2023; 16(2):292-294.
- [17] Kaszuba SM, Stewart MG. Medical management and diagnosis of chronic rhinosinusitis: a survey of treatment patterns by United States otolaryngologists. *Am J Rhinol*. 2006; 20(2):186-190.
- [18] Sahu N. Computed Tomography Grading of Nasal Obstruction Severity in Recurrent Acute Rhinosinusitis Patients. *SN Comprehensive Clinical Medicine*. 2022; 4(1):124.

-
- [19] Buljick-Cupic MM, Savovic SN. Endonasal endoscopy and computerized tomography in diagnosis of the middle nasal meatus pathology. *Med Pregl.* 2007; 60(7-8):327-332.
- [20] Rosenfeld RM, Andes D, Bhattacharyya N. Clinical Practice Guideline: Adult Sinusitis Executive Summary. *Otolaryngol Head Neck Surg.* 2007; 137:1-31.