

## Original Research Article

# Radiological significance of isolated ethmoid sinus infections in asymptomatic patients of recurrent acute rhinosinusitis

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## ABSTRACT

**Background:** Recurrent acute rhinosinusitis (RARS) being a low form chronic rhinosinusitis (CRS), is relatively under diagnosed many times because of lack of awareness regarding pattern of the disease presentation. Aim of the study is to evaluate the radiological significance of isolated ethmoid sinusitis in patients of RARS during the asymptomatic interval in between acute episodes of rhinosinusitis.

**Methods:** Total 124 patients with history suggestive of RARS who had undergone computed tomography study of brain during April 2015 to October 2016 for indications other than sinonasal diseases, were evaluated for isolated ethmoid sinusitis in the department of Radiology. Patients having any inflammatory or expansile sinonasal masses were excluded.

**Results:** Of total 124 patients of RARS aged from 18 to 70 years (mean age of 38.6 years), the study population included only seventy-two (58%) patients having isolated ethmoid sinus infections, were classified in to mild unilateral group I (46%) cases with grade I or II sinus infections and relatively severe bilateral group II (54%) cases having grade III or IV infections. Infective process involving two to three ethmoid cells each on either side is the most common variety encountered in 39% cases. Prevalence of infective process was fairly equal among all age groups. Statistical correlation between the severity of RARS in patients having group II variety of isolated ethmoid sinus infections was found highly significant.

**Conclusions:** Isolated ethmoid sinus infections are commonly encountered CT findings in adult RARS patients while they are asymptomatic from acute episodes of rhinosinusitis.

**Keywords:** Asymptomatic, Isolated ethmoid sinus infections, Recurrent acute rhinosinusitis

## INTRODUCTION

Rhinosinusitis (RS) is defined to be an inflammatory process of the nasal and paranasal sinus mucosa, which are classified as per the evolution of signs and symptoms, as acute (ARS; <4 weeks) or chronic (CRS; >12 weeks) with or without acute exacerbations.<sup>1</sup> Acute bacterial rhinosinusitis (ABRS) is diagnosed when symptoms or signs of acute rhinosinusitis fail to improve within 10

days or more beyond the onset of upper respiratory symptoms or symptoms or signs of acute rhinosinusitis worsen within 10 days after an initial improvement (double worsening). Diagnostic criteria for recurrent ARS (RARS) include the signs and symptoms of ABRS occurring four or more times in a twelve-month period, without persistent symptoms in between.<sup>2</sup> During this asymptomatic interval phase i.e., in between acute episodes of rhinosinusitis, a majority of RARS patients

demonstrated subtle findings of isolated ethmoid sinusitis while undergone for computed tomography (CT) scan of brain for any reasons other than sinonasal symptoms. Moreover, ethmoid sinusitis is the preliminary stage of infection in most cases of bacterial sinusitis.<sup>3</sup> Uncomplicated ethmoid sinus infections usually diagnosed retrospectively during radiological assessments for other indications.

Prior to the advent of antibiotics, mortality from meningitis originating from sinus infections were about 17%; whereas in this current era of high generation antibiotics it ranged from 1% to 2.5%.<sup>4</sup> Mild degree sinus infections are also suppressed frequently before presenting typical signs and symptoms due to inadvertent use of antibiotics. Superimposition of various ethmoid cells is the primary factor responsible for the incomplete delineation of ethmoiditis in standard sinus radiographs with varied radiographic position. A CT scan provides greater definition of the sinuses and is more sensitive than plain radiography for detecting sinus pathology, especially within the sphenoid and ethmoid sinuses.

The primary role of CT scans is to aid in the diagnosis and management of recurrent and chronic sinusitis, or to define the anatomy of the sinuses prior to surgery. CT imaging provides information about the status of the bony walls of the sinuses and the nature of the material within the sinuses. Studies on the pathogenesis of rhinosinusitis indicate that ethmoid sinus involvement plays a crucial role in the manifestation of recurrent frontal and maxillary sinusitis.<sup>5</sup> CT scan with axial sections enables effective and complete analysis of the ethmoid labyrinth. The present study aims to determine the significance and prevalence of subtle ethmoid sinusitis diagnosed on axial CT scans of brain in patients without having any acute symptoms of rhinosinusitis at the time of scan.

## METHODS

Total one hundred twenty-four patients having past history of rhinosinusitis suggestive of RARS who had undergone CT scan study of brain for any other reasons with no clinical indication of acute rhinosinusitis at the time of scan were included in the study. The patients of RARS were within asymptomatic interval phase between two consecutive acute episodes of rhinosinusitis, so called asymptomatic patients. Axial CT images of these cases were evaluated in the department of Radiology during April 2015 to October 2016. Patients with history of craniofacial trauma or surgery, acute rhinosinusitis at the time of scan were excluded from the study. The study population aged 18-70 years (mean age 42.6 year) consisted of 66 males and 58 females. Patients having any inflammatory or expansile sinonasal masses were excluded.

The CT scan study was performed with a 125 multi-slice GE health care CT scanner. Contiguous 5-mm thick axial supra-tentorial slices and additional 3-mm thick axial

posterior fossa slices were taken with the head in supine as this position is comfortable for the patient and reduces radiation to the sensitive lenses of the eyeballs. Axial imaging of brain was performed with a 15- to 20-degree angulations of the CT machine gantry to the canthomeatal line. Routine head scans are usually done at a window level of 34-40 and a window covering 0-75. The CT images were obtained at a wide window setting to favor the demonstration of intra-sinus soft tissue attenuations as well as bony algorithm used to review the bony details of the facial bones. The sections were also reviewed at narrow window settings as such windows are useful to demonstrate trapped secretions.

Herein our purpose was to evaluate the prevalence of subtle ethmoid sinus infections in asymptomatic adults and not to conclude a definite diagnosis. As the main focus was on ethmoid sinus region only, the sections purely depicting the ethmoid labyrinth were reviewed. Taking the thickness of the slices in to consideration limited axial sections were displayed owing to the relatively small cranio-caudal extent of the ethmoid labyrinth. Other paranasal sinuses were totally ignored as the abnormalities of these sinuses were not included in the present study.

## RESULTS

Axial CT slices through the ethmoid labyrinth delineated normal and abnormal ethmoid cells with remarkable clarity. Basic abnormalities in the form of hypertrophic mucosal wall thickening or opacified ethmoid cell due to fluid collection with or without hypertrophic mucosa were noted. Unilateral or bilateral affection of either single ethmoid cell or combination of multiple cells by the infective process was also recorded. The extent and type of observed ethmoid abnormalities did not include any expansile mass lesion or bony erosion.

Out of total 124 asymptomatic RARS patients of the study population, seventy-two (58%) were found to have some degree of ethmoid sinus infections; whereas fifty-two (42%) cases had a normal CT appearance of the ethmoid labyrinth. Total 72 cases with varying severity of ethmoid sinus infections were grouped into two major categories as per the presented history suggestive of either severe (52 cases) or mild (20 cases) degree of RARS disease. No statistical significance of age and gender distribution found with the grading of ethmoid sinus infections.

The severity of the infective process was graded according to bi- or unilateral affection as well as the number of ethmoid cells involved as grade I, unilateral one cell; grade II, unilateral two or three cells; grade III, two or three cells each on either side, or grade IV, four or more cells affected on either side. Total 72 cases with history of RARS having ethmoid abnormality were further grouped into two major categories as group I including grade I or II types having unilateral affection of

the infective process, and group II comprising of grade III or IV types with bilateral disease process. All age groups had shown almost similar prevalence of ethmoid cell

infections. Severity of RARS in group II cases was found highly significant ( $p=0.0003$ , Table 1).

**Table 1: Statistical analysis of significance of asymptomatic isolated ethmoid sinusitis in seventy-two patients having varying severity of recurrent acute rhinosinusitis.**

Severity of RARS	Group I ethmoid cell infections			Group II cases ethmoid cell infections			p -value
	Grade I	Grade II	Total	Grade III	Grade IV	Total	
Severe	06	12	18	25	09	34	0.003
Mild	09	06	15	03	02	05	
Total	15	18	33	28	11	39	

## DISCUSSION

Being characterized as a low form of CRS, RARS is relatively uncommon when compared with the traditional CRS. Furthermore, because of lack of awareness of RARS as a distinct form of CRS, it is possible that RARS would have been under diagnosed many times.<sup>6</sup> Between two consecutive acute episodes of rhinosinusitis i.e., during the asymptomatic interval phase majority of patients with history of RARS disease who had undergone CT scan of brain for any reasons other than sinonasal symptoms had shown subtle findings of isolated ethmoid sinusitis, which frequently goes unnoticed being the potential nidus of bacterial infections.<sup>4</sup>

The important role of ethmoid sinus disease has been implicated in different studies revealing the genesis of recurrent frontal or maxillary sinusitis.<sup>5</sup> This may be considered as criteria for the diagnosis of RARS and to determine its prevalence in the general population as because RARS is relatively less common than CRS and the key diagnostic element of RARS is a comparatively sporadic diagnosis done many times by many different physicians even within the same patient. Therefore, a systematic radiologic evaluation is detrimental in establishing the involvement of the ethmoid sinuses in recurrent sinusitis cases. Unlike the frontal, maxillary and sphenoid sinuses, the ethmoid labyrinth is less delineated in standard radiologic views due to superimposition of ethmoid cells and complexity of the ethmoid labyrinth. Moreover, low air density in adjacent normal cells can mask a group of opacified cells.

On the contrary, axial CT sections effectively demonstrate the ethmoid labyrinth. Thinly collimated CT slices contribute to the precise assessment of the very minimal ethmoid abnormalities. The coronal plane is helpful for pre-operative assessment prior to endoscopic sinus surgeries due to its effective delineation of the anatomy of the osteomeatal unit.<sup>5</sup> Intra-sinus soft-tissue attenuations often encountered on the CT scans of asymptomatic patients represent either a chronic

inflammatory process or scarring. For conservative and selective surgical treatment of ethmoid diseases, the frequency of such lesions in asymptomatic patients should be revealed at right time. As reported in a study, young adolescent children have frequent sinus infections without clinical symptoms of sinusitis, which can be explained in the context that upper respiratory tract infections are frequent in children and other causes include redundant sinonasal mucosa and abundant tears from frequent crying.<sup>7</sup> Patients with RARS should properly assessed for any associated chronic conditions such as asthma, cystic fibrosis, ciliary dyskinesia and immunocompromised state, which usually modify its management include. The knowledge of accompanying comorbid conditions also improves its management, even few conditions that require therapy independent of RARS.<sup>1</sup> Improve patient quality of life by identifying and managing allergies that often coexist with RARS and have overlapping symptoms that may make diagnosis difficult using strictly clinical criteria without any radiological evaluation. Despite the high prevalence and economic impact of RARS, considerable practice variations exist across and within the multiple disciplines involved in managing the condition.<sup>8</sup>

CT scan has been frequently used by the clinicians to make diagnosis, delineate disease extent and identify the involved sinonasal structures.<sup>9</sup> It further serves as a road map for the surgeons during endoscopic sinus and base of skull surgeries.<sup>10</sup> Though relatively good prevalence and significant disease persistence encountered in this study, it seems that the usefulness of the diagnostic modality such as sinonasal CT evaluation is underused for the diagnosis of RARS keeping the disease under evaluated many times.<sup>4</sup> The correlation between sinonasal symptoms and the CT findings in case of CRS is statistically significant as reported.<sup>11</sup> As RARS is a low form of the traditional CRS, the combination of CT findings and overall disease severity always provide an ideal way for clinicians to better grade the patients' disease. MR imaging can also analyze the ethmoid sinus disease but difference of results may occur probably due to less sensitivity of MR for detecting fibrosis, showing

low signal intensities on both the T1- and T2-weighted images, which can be better delineated on CT scan. Clinicians should distinguish CRS and RARS from isolated episodes of ABRS by raising awareness of these distinct clinical entities for implementation of beneficial management strategies.<sup>12</sup>

## CONCLUSION

Present study concluded that isolated ethmoid sinus infections are frequent CT findings in adult RARS patients during their asymptomatic phase in between acute episodes of rhinosinusitis. The disease process was found most commonly localized to two to three ethmoid cells each on either side showing no significant prevalence in any specific age or gender group. RARS constitutes a relatively smaller fraction of CRS, as diagnostic and therapeutic interventions are likely to be underused in case of RARS due to lack of awareness regarding its disease pattern. This study may find helpful to determine the optimal timely diagnostic option for RARS disease.

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