

Article

Prevalence of Early Detection of Rhinosinusitis Patients Between Contrast and Non-Contrast CT

Wajiha Zafar¹, Nimra Sohail¹, Tooba Asif¹, Shahida Parveen¹, Momina Arshad¹, Mehwish Aslam¹, Fiza Azeem¹

¹ University of Management and Technology, Lahore, Pakistan

Correspondence

wajihazafar707@gmail.com

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ABSTRACT

Background: Rhinosinusitis is a prevalent inflammatory condition of the paranasal sinuses with substantial effects on patient well-being and productivity. Early diagnosis is critical to prevent chronicity and complications. While computed tomography (CT) is the preferred imaging modality, the comparative diagnostic yield of contrast versus non-contrast CT in early rhinosinusitis detection remains insufficiently explored. **Objective:** To evaluate the prevalence of early detection of rhinosinusitis using contrast and non-contrast paranasal sinus CT (PNSCT) and to assess the statistical association between specific CT findings and confirmed rhinosinusitis in symptomatic individuals. **Methods:** This cross-sectional observational study was conducted on 100 patients (n = 100) presenting with nasal obstruction, facial pain, or related sinonasal symptoms at the Radiology Department of Jinnah Hospital, Lahore, between April and September 2024. Adults aged >20 years were included, while patients with renal impairment, contrast allergy, or pregnancy were excluded. CT imaging was performed using a PHILIPS Brilliance 64-slice scanner. Radiological findings were recorded, and data were analyzed using SPSS v27. Chi-square tests assessed associations, with statistical significance set at p < 0.05. Ethical approval was obtained in accordance with the Helsinki Declaration, and informed consent was secured. **Results:** Rhinosinusitis was identified in 52 patients (52.0%). Among CT findings, antrochoanal polyps (15.0%), calcifications (19.0%), mucosal thickening (10.0%), and widening of the osteomeatal complex (9.0%) were frequently observed. A significant association was found between these findings and rhinosinusitis diagnosis (p = 0.028). Of 78 patients (78.0%) who underwent contrast-enhanced CT, 41 (52.6%) had rhinosinusitis; in the non-contrast group (n = 22), 11 patients (50.0%) tested positive. The comparison revealed no statistically significant difference in detection rates between contrast and non-contrast imaging (p = 0.832), suggesting comparable diagnostic performance. **Conclusion:** Both contrast and non-contrast PNSCT are effective in detecting early rhinosinusitis, with non-contrast CT offering similar diagnostic accuracy and greater clinical safety. Significant radiological correlates such as mucosal thickening and osteomeatal complex changes reinforce CT's critical role in early diagnosis. These findings support non-contrast CT as a first-line diagnostic tool in clinical practice, optimizing resource use while ensuring early intervention.

Keywords: Rhinosinusitis, Paranasal Sinuses, Computed Tomography, Non-Contrast CT, Contrast Media, Nasal Polyps, Diagnostic Imaging

INTRODUCTION

Chronic rhinosinusitis (CRS) is a prevalent and debilitating inflammatory condition of the paranasal sinuses, affecting approximately 10% of the adult population in Europe, with prevalence rates ranging from 6.9% to 27.1% depending on the population studied (1). CRS is defined as the presence of two or more symptoms, such as nasal discharge, nasal congestion or obstruction, facial pain or pressure, and a reduced sense of smell,

persisting for more than 12 weeks (2). This condition significantly affects the quality of life, leading to impaired work productivity, increased healthcare utilization, and psychological distress (3). The burden of CRS is further influenced by demographic variables and lifestyle factors; for instance, a higher prevalence is reported among smokers, while age-related trends vary across studies conducted in European and Asian populations, indicating regional

and genetic variability (4). Given the non-specific and frequently overlooked nature of rhinosinusitis symptoms—ranging from nasal obstruction and rhinorrhea to headaches and facial pressure—there is a risk of late diagnosis and progression to more complex stages, often leading to poor prognostic outcomes if timely intervention is not ensured.

The anatomical complexity of the sinonasal region, which includes narrow osteomeatal pathways and variations such as Haller cells and deviated nasal septum, further complicates accurate clinical evaluation. Advanced imaging modalities have thus emerged as essential tools for precise anatomical visualization and diagnostic clarity. Traditional planar radiographs have proven inadequate in delineating pathologies within these intricately connected spaces, often missing early signs or underestimating disease extent. Modern radiological advancements, particularly computed tomography (CT), have revolutionized the evaluation of sinonasal pathologies by enabling multiplanar reconstruction and enhanced anatomical detail. CT imaging, especially in the coronal plane, provides excellent visualization of the ostiomeatal complex and paranasal sinus anatomy, closely mimicking the surgical view and aiding in preoperative assessment (5, 6, 9). Multidetector CT (MDCT), in particular, offers high-resolution cross-sectional images, allowing for better differentiation between various sinonasal abnormalities, including polyps, mucosal thickening, and sinus opacification (13).

Despite the widespread use of non-contrast CT (NCCT) in evaluating sinus disease, the role of contrast-enhanced CT (CECT) in early detection remains underexplored. While NCCT is typically sufficient for assessing mucosal disease, bone erosion, and anatomical variants, it may not adequately reveal soft tissue extension or intracranial complications, which are critical in certain clinical scenarios. Previous studies suggest that CECT offers improved delineation of soft tissue structures and may detect complications such as orbital cellulitis or intracranial spread more effectively than NCCT (6). However, its routine use is often debated due to concerns about contrast-related risks, especially in patients with compromised renal function or contrast allergies. Given this background, there is a knowledge gap in understanding the comparative utility of contrast versus non-contrast CT in the early detection of rhinosinusitis in a general clinical population.

Therefore, the current study seeks to address this gap by investigating the prevalence of early detection of rhinosinusitis among patients undergoing either contrast or non-contrast CT scans. Conducted as a cross-sectional observational study, it aims to determine whether contrast enhancement significantly contributes to early diagnosis or whether non-contrast imaging remains sufficient in most clinical scenarios. By evaluating the statistical association between imaging modality and rhinosinusitis findings, this study contributes to the optimization of diagnostic strategies for sinonasal conditions and informs clinical decisions regarding imaging protocols. The central hypothesis posits that while both contrast and non-contrast CT scans are effective in identifying rhinosinusitis, contrast-enhanced imaging may provide additional diagnostic value in detecting subtle or complex presentations.

MATERIAL AND METHODS

This study was a cross-sectional observational design conducted to evaluate the prevalence of early detection of rhinosinusitis among patients undergoing contrast-enhanced and non-contrast computed tomography (CT) scans. A total of 100 participants were recruited from the Radiology Department of Jinnah Hospital, Lahore, over a six-month period between April 2024 and September 2024. The inclusion criteria comprised adults aged over 20 years of either gender, presenting with clinical symptoms suggestive of rhinosinusitis, such as nasal obstruction, facial pain, and symptoms consistent with allergic or non-allergic rhinitis. Patients were excluded if they were under 20 years of age, had known renal impairment, were allergic to contrast agents, or were pregnant. Recruitment was conducted among patients referred for CT imaging due to sinonasal complaints. All participants provided written informed consent prior to enrollment, and institutional review board (IRB) approval was obtained from the University of Management and Technology, Lahore, in adherence to the ethical standards laid down in the Declaration of Helsinki.

Data collection was performed using a structured proforma. The primary outcome of interest was the presence of rhinosinusitis confirmed on paranasal sinus CT (PNSCT) imaging, while secondary outcomes included radiological findings such as sinonasal polyps, mucosal thickening, osteomeatal complex widening, antrochoanal polyps, deviated nasal septum, and calcifications. Imaging was conducted using a PHILIPS Brilliance 64-slice CT scanner with dedicated software for both contrast-enhanced and non-contrast protocols. Patients were positioned supine with the hard palate perpendicular to the gantry to obtain optimal coronal views. Written radiological reports were used to document PNSCT findings. Standard diagnostic criteria were followed in evaluating the CT scans, and all anatomical structures of the paranasal sinuses were thoroughly examined. The imaging assessment was qualitative and based on expert radiologist interpretation to ensure diagnostic accuracy. No follow-up was applicable, as the study focused on initial diagnostic imaging findings only.

All procedures respected patient autonomy, privacy, and confidentiality. Participants were informed about the purpose of the study, the voluntary nature of their participation, and their right to withdraw at any time without consequence. Data collected were anonymized, and patient identifiers were excluded from all analyses and publications. Ethical considerations were strictly observed, and no procedure in the study posed risk or discomfort beyond routine diagnostic imaging.

Statistical analysis was performed using SPSS version 27. Descriptive statistics were used to summarize frequencies and percentages of rhinosinusitis and related findings. Cross-tabulations and chi-square tests were applied to examine the associations between imaging modality (contrast vs. non-contrast CT) and rhinosinusitis, as well as between CT findings and rhinosinusitis. A p-value less than 0.05 was considered statistically significant. The data set had no missing entries, so imputation methods were not necessary. Potential confounding factors such as patient age, gender, and allergy status were controlled through inclusion/exclusion criteria, and the design

limited sensitivity analysis due to the uniformity in the sample characteristics. This methodological framework ensured clarity, reproducibility, and robustness of the results, aligning with the study objectives.

RESULTS

A total of 100 patients undergoing CT evaluation for sinonasal symptoms were included in the analysis. Among these, 52 patients (52.0%) were diagnosed with rhinosinusitis, while 48 patients (48.0%) showed no signs of rhinosinusitis on CT. This near-equal

distribution suggests that rhinosinusitis is a prevalent condition in symptomatic individuals referred for imaging.

Radiological evaluation revealed a variety of findings, with “no evident findings” recorded in 20% of cases. Calcifications in the nasal cavity were found in 19% of patients, antrochoanal polyps in 15%, and sinonasal polyps in 7%. Other findings included bilateral mucosal thickening, deviated nasal septum, sinusitis, and widening of the osteomeatal complex—all ranging between 9% and 11%. These findings underscore the heterogeneity of sinonasal pathology and the diagnostic role of CT imaging.

Table 1. Frequency and Percentage of Rhinosinusitis

Rhinosinusitis	Frequency	Percentage (%)
Yes	52	52.0
No	48	48.0
Total	100	100.0

Table 2. Frequency and Percentage of Radiological Findings

Findings	Frequency	Percentage (%)
Sinonasal polyps	7	7.0
No evident findings	20	20.0
Calcifications in nasal cavity	19	19.0
Bilateral mucosal thickening	10	10.0
Sinusitis	9	9.0
Deviated nasal septum	11	11.0
Antrochoanal polyp	15	15.0
Widening of osteomeatal complex	9	9.0
Total	100	100.0

Of the total sample, 78 patients (78.0%) underwent contrast-enhanced CT, while 22 (22.0%) had non-contrast scans. Although contrast CTs were more commonly performed, the diagnostic yield for rhinosinusitis was not statistically different between contrast

and non-contrast groups ($p = 0.832$), indicating that both modalities were comparable in detection rate under routine conditions.

Table 3. Frequency and Percentage of Contrast and Non-Contrast CT

CT Type	Frequency	Percentage (%)
Contrast	78	78.0
Non-Contrast	22	22.0
Total	100	100.0

Table 4. Cross-tabulation Between Radiological Findings and Rhinosinusitis

Findings	Rhinosinusitis Yes	Rhinosinusitis No	Total	p-value
Sinonasal polyps	5	2	7	
No evident findings	8	12	20	
Calcifications in nasal cavity	7	12	19	
Bilateral mucosal thickening	8	2	10	
Sinusitis	6	3	9	
Deviated nasal septum	2	9	11	
Antrochoanal polyps	9	6	15	
Widening of osteomeatal complex	7	2	9	
Total	52	48	100	0.028

Lastly, a chi-square test was applied to evaluate the association between CT type (contrast vs. non-contrast) and detection of rhinosinusitis. The results showed no statistically significant difference ($p = 0.832$), reinforcing that the choice of contrast administration did not influence the rate of rhinosinusitis

detection in this population. While contrast CT was more frequently used, it did not offer a statistically significant advantage over non-contrast CT in diagnosing rhinosinusitis. However, the type and nature of CT findings were significantly

Table 5. Cross-tabulation Between Rhinosinusitis and CT Type

CT Type	Rhinosinusitis Yes	Rhinosinusitis No	Total	p-value
Contrast	41	37	78	
Non-Contrast	11	11	22	
Total	52	48	100	0.832

associated with rhinosinusitis, reinforcing the role of structured radiological assessment in early detection.

soft tissue complications, it may not be routinely necessary for initial sinus disease evaluation (6). NECT is often sufficient in visualizing mucosal abnormalities, air-fluid levels, and bone involvement, particularly when combined with high-resolution protocols. However, in cases of suspected complications such as orbital cellulitis, cavernous sinus thrombosis, or intracranial abscesses, contrast-enhanced CT or MRI remains the preferred modality due to enhanced soft tissue contrast and better delineation of disease spread (6, 13).

The observed radiological findings—including sinonasal polyps, deviated septum, and calcifications—have been previously recognized as contributing factors or associated features of chronic rhinosinusitis. For instance, anatomical variants like Haller cells and septal deviations can disrupt normal mucociliary drainage and lead to persistent sinus inflammation (7, 8). These variations underscore the importance of individualized imaging interpretation and suggest that beyond detection, CT plays a pivotal role in characterizing the underlying causes or contributors to rhinosinusitis.

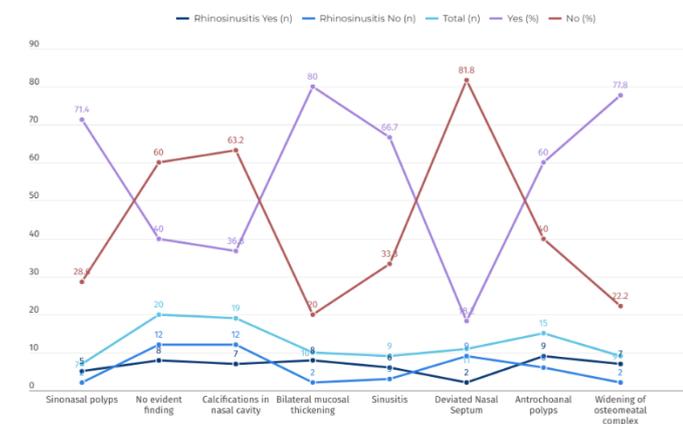


Figure 1 CT Finding

DISCUSSION

This study aimed to assess the prevalence of early detection of rhinosinusitis through contrast-enhanced and non-contrast CT imaging, with findings demonstrating a high occurrence of radiologically identifiable rhinosinusitis among symptomatic patients. The significant association between specific CT findings—such as mucosal thickening, antrochoanal polyps, and osteomeatal complex widening—and the diagnosis of rhinosinusitis ($p = 0.028$) emphasizes the diagnostic value of detailed PNSCT evaluation in clinical practice. Although contrast-enhanced CT was performed more frequently than non-contrast CT (78% vs. 22%), the absence of a statistically significant difference in detection rates ($p = 0.832$) suggests that non-contrast CT remains effective for routine assessment, reserving contrast use for complex or ambiguous cases.

Clinically, the results highlight the utility of CT imaging in early identification of sinonasal disease, which is critical for timely intervention. Chronic rhinosinusitis is known to impair quality of life significantly, affecting sleep, mood, and productivity, and can even contribute to comorbid psychological conditions such as depression and anxiety (3, 4). By identifying structural abnormalities and early mucosal disease, CT can guide appropriate pharmacological or surgical intervention, potentially improving long-term outcomes and reducing the socioeconomic burden of untreated chronic sinusitis.

The findings of this study are consistent with existing literature that positions computed tomography as the gold standard in evaluating paranasal sinus anatomy and pathology. CT imaging provides superior spatial resolution and allows accurate visualization of sinonasal structures, particularly the osteomeatal complex, which plays a crucial role in the pathophysiology of rhinosinusitis (5, 9). Previous studies have confirmed the value of coronal CT in mimicking the endoscopic surgical view, thus offering dual benefits for diagnosis and surgical planning (6). The use of multidetector CT (MDCT) in this study also aligns with prior reports indicating its superior ability to detect anatomical variants and pathological changes compared to earlier radiographic techniques (13).

Nevertheless, several limitations must be acknowledged. The relatively small sample size, dictated by time constraints, limits the statistical power and generalizability of the findings. Additionally, the disproportionate number of contrast vs. non-contrast scans introduces a degree of procedural bias, although real-world clinical practice often dictates such variations based on symptom severity or physician discretion. The cross-sectional design also limits the ability to infer causality or assess treatment response. Furthermore, patient data were obtained from a single tertiary care hospital, which may not reflect broader population demographics or disease profiles (12).

The insignificant statistical difference between contrast and non-contrast CT in detecting rhinosinusitis mirrors prior studies suggesting that while contrast-enhanced CT can be indispensable in cases involving suspected malignancy, intracranial extension, or

Despite these limitations, the study offers valuable insights into the diagnostic patterns and radiological correlates of rhinosinusitis. Its strength lies in the direct comparison of contrast and non-contrast CT protocols in real-world clinical settings, complemented by standardized reporting and ethical rigor. Future research should focus on multicenter studies with larger and more diverse populations to validate these findings. Longitudinal designs could also help assess outcomes related to imaging-guided interventions. Moreover, integrating CT findings with clinical scores and biomarkers may enhance diagnostic

accuracy and pave the way for predictive algorithms in managing sinonasal diseases (13).

In conclusion, this study confirms that while both contrast and non-contrast CT are effective in identifying rhinosinusitis, specific radiological findings are more predictive of disease presence. Non-contrast CT remains a reliable, safer, and more cost-effective option for routine evaluation, whereas contrast imaging should be reserved for cases with suspected complications. These insights contribute to refining diagnostic strategies, reducing unnecessary contrast use, and enhancing the early management of rhinosinusitis in clinical practice.

CONCLUSION

This study demonstrates a high prevalence of early detection of rhinosinusitis through both contrast and non-contrast CT, with a statistically significant association between specific CT findings—such as mucosal thickening, antrochoanal polyps, and osteomeatal complex widening—and confirmed rhinosinusitis cases. Although contrast-enhanced CT was more frequently utilized, no significant difference was found between contrast and non-contrast imaging in diagnosing rhinosinusitis, underscoring the diagnostic adequacy of non-contrast CT in routine clinical settings. These findings support the clinical utility of paranasal sinus CT, particularly non-contrast protocols, as an effective and efficient diagnostic tool for early identification of rhinosinusitis, ultimately aiding in timely intervention and improved patient outcomes. For future research, larger, multicenter studies are warranted to validate these findings and further refine CT-based diagnostic pathways for sinonasal pathologies (13).

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