

Computed Tomographic Evaluation of Radiological Findings in Sinonasal Diseases

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Abstract:

Background: Sinus infections can be described as various kinds of inflammation, infections, allergies or even neoplasms involving the nose cavities and para nasal sinuses. The diagnosis of these disease states has proven difficult since there exists an overlap between their symptoms, besides the complex structure of the sinonasal area. The Computed Tomography of Paranasal Sinuses (CT PNS) has become the method of choice for the assessment of these diseases.

Aim: In terms of radiographic examination for the assessment of the results of sinonasal diseases among the patients using CT scan PNS and evaluation of the sinus pattern.

Methodology: This study was conducted by the method of observation for a period of one year, taking into account the cases admitted to the Department of Radiodiagnosis, ICARE Institute of Medical Sciences & Research and Dr. Bidhan Chandra Roy Hospital, Haldia, West Bengal, India. Total number of patients taken into consideration was 110, considering that they suffered from sinus-nasal pathology on the basis of referral to CT PNS. CT scan images were examined for any sinus involvement, mucosal lesions, obstruction in osteomeatal complex and anatomic anomalies. SPSS 26.0 was used for statistical analysis, and results are represented in frequencies and percentage.

Results: Most patients had age range between 31-40 years (30.9%), with male sex dominating 58.2% of participants. Nasal obstruction is the most common clinical manifestation of the disorder, comprising 70.9% of the cases. The most frequently involved sinuses include maxillary sinuses, which comprised 74.5% of the cases, while the ethmoidal sinuses comprised 61.8% of the cases. On radiographic examination, thickening of the sinus mucosa and opacification of the sinuses may be found in 77.3% and 65.5%, respectively. Anatomical variations commonly reported include deviation of nasal septum accounting for 52.7% of patients.

Conclusion: CT PNS was found to be very useful in imaging modality in relation to the evaluation of sinonasal diseases. This technique provided an efficient method of diagnosing different types of disease patterns, sinusitis, and variations in anatomy.

Keywords: Sinonasal Diseases, Computed Tomography, CT PNS, Paranasal Sinuses, Chronic Rhinosinusitis, Radiological Findings.

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Introduction

Sinonasal diseases refer to the diseases caused by inflammation, infection, allergy or neoplasia in the nasal cavity and paranasal sinuses [1]. It should be noted that these types of diseases are rather widespread among the patients who are visited by otorhinolaryngologists [2]. Sinonasal diseases usually result in such symptoms as congestion in the nose, rhinitis, facial pain, headache, anosmia, and sinusitis [3]. Therefore, proper diagnosis of the aforementioned disorders and the determination of

the stage at which it takes place, is vital in order to provide effective therapy and prevent further complications [4]. Despite the effectiveness of some diagnostic methods such as physical examination and endoscopy, there still remain the cases where they prove to be insufficient [5].

However, computed tomography of paranasal sinuses (CT PNS) became an invaluable tool for diagnosing the sinonasal diseases because of its remarkable sensitivity and resolution capabilities,

which allow obtaining detailed images of the soft tissues [6]. In particular, CT PNS proves to be quite effective in case of diagnosis of abnormalities in mucosa, sinuses' opacification, occlusion of ostiomeatal complex, anatomical anomalies, and neoplasia [7]. Moreover, this imaging method helps distinguish between various types of pathologies and is an integral part of surgical planning [8]. It has become possible to diagnose and treat sinonasal diseases much better due to the accuracy of CT in revealing the extent of the lesion [9].

Due to the rising incidence of sinonasal disorders and the importance of their radiological diagnosis, the knowledge of CT findings is critical for the effective treatment [10]. Knowing the peculiarities of sinus pathology and typical radiologic abnormalities and variations can facilitate early diagnosis and the development of adequate treatment strategy [11]. That is why, the current research is aimed at studying the characteristics of CT findings in patients suffering from sinonasal disorders [12].

Background of the Study

Diseases of the sinonasal tract are said to represent a serious issue for people globally considering the large number of patients with this disease and its tremendous impact on their health [13]. First of all, by diseases of the sinonasal tract we mean an entire range of inflammation-related, infectious, allergic, and neoplastic problems in the nasal tract and paranasal sinuses. Some of the symptoms associated with this disease include congestion in the nasal tract, headaches, facial pain, rhinorrhea, and anosmia [14]. It should be noted that the diagnostic process for sinonasal diseases could be rather complicated due to the commonality of clinical features and intricate structure of the area. In modern medicine, Computed Tomography of Paranasal Sinuses (CT PNS) is known to be considered the gold standard for the detection of pathologies within the area under discussion since it offers an excellent opportunity to examine the pathological processes and anatomical changes. Thus, the evaluation of the radiological features of sinonasal diseases with CT PNS can significantly improve the quality of diagnosis and management of the disease [15].

Objectives of the Study

1. To evaluate the spectrum of radiological findings in patients with sinonasal diseases using Computed Tomography of the Paranasal Sinuses (CT PNS).
2. To determine the frequency and distribution of various sinonasal pathologies and sinus involvement identified on CT PNS.
3. To assess the prevalence of anatomical variations of the sinonasal region and their

association with sinonasal diseases on CT imaging.

4. To analyze the demographic and clinical profile of patients with sinonasal diseases undergoing CT PNS examination.

Methodology

In the current research work, an attempt was made to investigate the radiologic characteristics of different sinonasal diseases through CT of paranasal sinuses. The CT examination was selected for the evaluation of different diseases of the sinus and nose because it is a very accurate investigation technique for diagnosing sinonasal structures and abnormalities in them.

Study Design: This research was conducted in the Department of Radiodiagnosis at ICARE Institute of Medical Sciences & Research and Dr. Bidhan Chandra Roy Hospital, Haldia, West Bengal, India. It is a tertiary care hospital where a large number of patients coming from the city of Haldia along with its surrounding areas in West Bengal receive treatment. This hospital receives many referrals in connection with the diagnosis and treatment of various sinonasal diseases. Thus, it was an appropriate location to conduct this study using CT PNS in the investigation of sinonasal diseases.

Study Area: The investigation was conducted at the Department of Radiodiagnosis, in association with the Department of Otorhinolaryngology (ENT), ICARE Institute of Medical Sciences & Research, and Dr. Bidhan Chandra Roy Hospital, Haldia, West Bengal, India.

Study Duration: The experiment took place for a period of one year.

Study Participants: The study sample comprised individuals with signs that could suggest sino-nasal pathologies, referred by the ear, nose, and throat (ENT) department for CT PNS imaging.

Inclusion Criteria

- Patients aged 18 years and older.
- Patients having any symptom such as nasal blockage, nasal secretions, facial pain, headache, nose bleed, loss of smell sense, or recurring sinus infections.
- Patients who had undergone CT PNS investigation during the period of the study.
- Patients who had provided consent for participation in the study.

Exclusion Criteria

- Patients having undergone sinonasal surgery before.
- Patients who have experienced facial trauma involving the paranasal sinuses before.
- Patients who possess inferior quality CT scans.

- Patients who do not have complete medical records.
- Those who are pregnant and those who are unwilling to take part in the study.

Sample Size: The total number of people recruited in the experiment is 110, all of whom fulfilled the inclusion criteria. This technique used in subject selection for the experiment is consecutive sampling whereby all the eligible patients who went through the CT PNS technique were selected.

Procedure: A proforma was filled for each selected patient to note detailed demographic and clinical data such as age, gender, symptoms, duration of illness, and history of other diseases. Then, all the selected patients were examined using CT PNS imaging with a multidetector computed tomography machine following the protocol of the imaging department.

The axial images of the paranasal sinuses were reconstructed in coronal and sagittal planes where required. The CT findings were then interpreted by the radiologist to detect the presence of any pathology in the sinonasal area:

- Mucosal thickening
- Sinus opacification
- Air-fluid levels
- Nasal Septum Deviation
- Concha bullosa
- Osteomeatal complex obstruction
- Nasal polyps
- Sinonasal masses
- Bony erosion and remodeling

- Anatomical variations of the paranasal sinuses

The participation of the maxillary, ethmoid, frontal, and sphenoid sinuses was noted. The presence of all radiographic findings was meticulously documented and classified based on the type of sinonasal disorder.

Statistical Analysis: The collected data was then analyzed using Microsoft Excel with Statistical Package for Social Sciences version 26.0. The following analysis will be done using descriptive statistics. For continuous data, mean and standard deviations were calculated, while for categorical data, frequency and percentage were calculated.

Chi-square test was employed to establish any relation that existed between the demographic profile of the subjects and their radiological findings. P value lower than 0.05 was used to prove statistical significance of the results. Results were represented using tables and graphs.

Results

The age-related distribution of participants is presented in Table 1. Out of the total of 110 individuals analysed in the study, 30.9% fell within the 31-40 years age range, 28 being in this age category. The 18-30-year age category comprised of 25.5% patients, i.e., 28 in number. Individuals aged 41-50 years formed 21.8% of the sample. Only 8.2% of the sample consisted of individuals above 60 years. It appears that sinonasal disease is common among young adults and middle-aged patients.

Table 1: Distribution of Patients According to Age Group

Age Group (Years)	Frequency (n)	Percentage
18-30	28	25.5
31-40	34	30.9
41-50	24	21.8
51-60	15	13.6
>60	9	8.2
Total	110	100.0

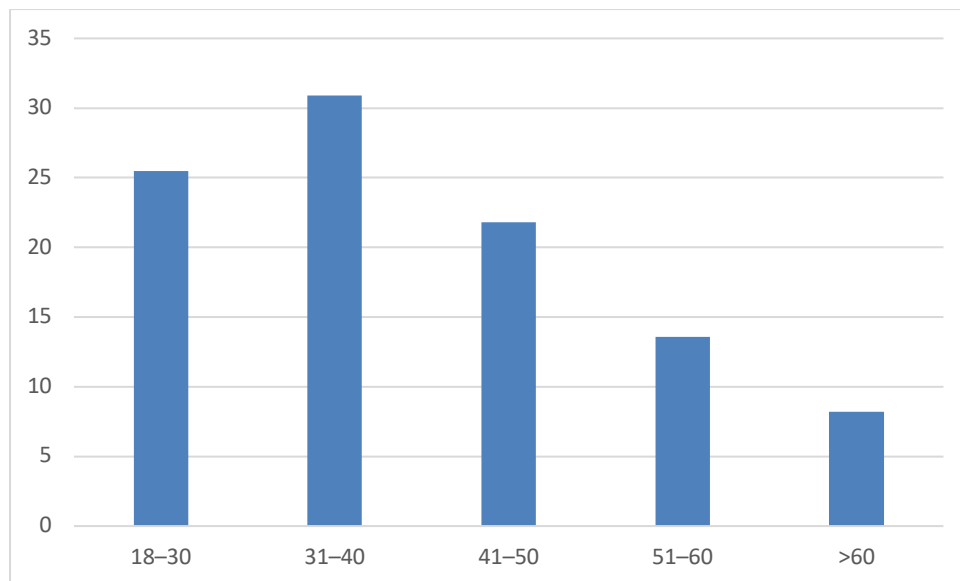


Figure 1: Graphical Representation of the Percentage of Distribution of Patients According to Age Group

Table 2 presents the number of genders included in the sample. There were 110 subjects consisting of 64 men (58.2%) and 46 women (41.8%). There was

a male-female ratio of 1.4:1. Since there were more men who joined this study, then it can be said that sinus ailments are more common among men.

Gender	Frequency (n)	Percentage
Male	64	58.2
Female	46	41.8
Total	110	100.0

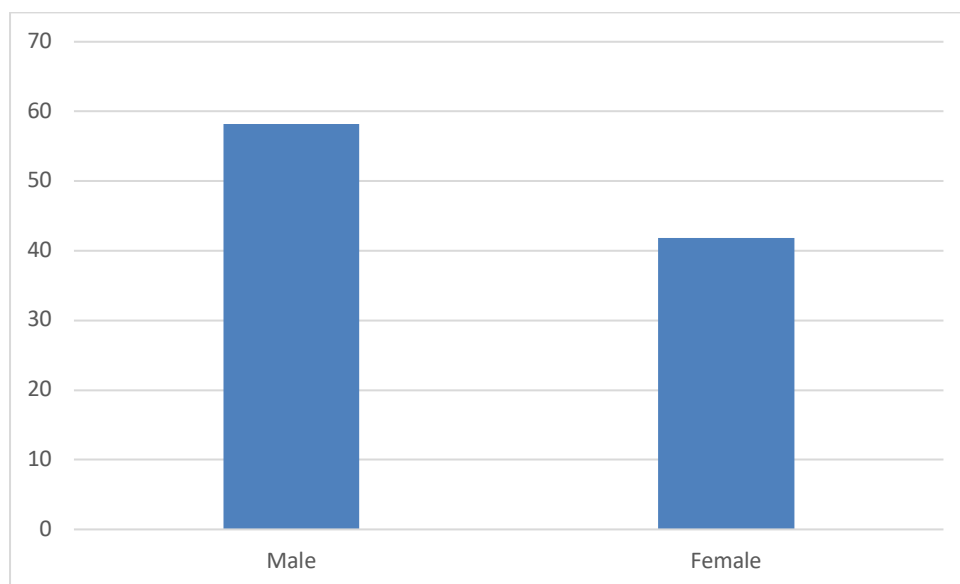


Figure 2: Graphical Representation of the Percentage of Distribution of Patients According to Gender

Table 3 gives an indication of the prevalence of various clinical features amongst the patients diagnosed with the sinonasal disorders. The most common clinical feature was nasal obstruction, which occurred in 78 cases (70.9%). The symptoms of headache occurred in 65 cases (59.1%), and

nasal discharge was present in 60 patients (54.5%). The third most common symptom was facial pain with a prevalence of 43.6%. Anosmia and epistaxis both had a prevalence of 22.7% and 10.9%, respectively.

Symptom	Frequency (n)	Percentage (%)
Nasal Obstruction	78	70.9
Headache	65	59.1
Nasal Discharge	60	54.5
Facial Pain	48	43.6
Anosmia	25	22.7
Epistaxis	12	10.9

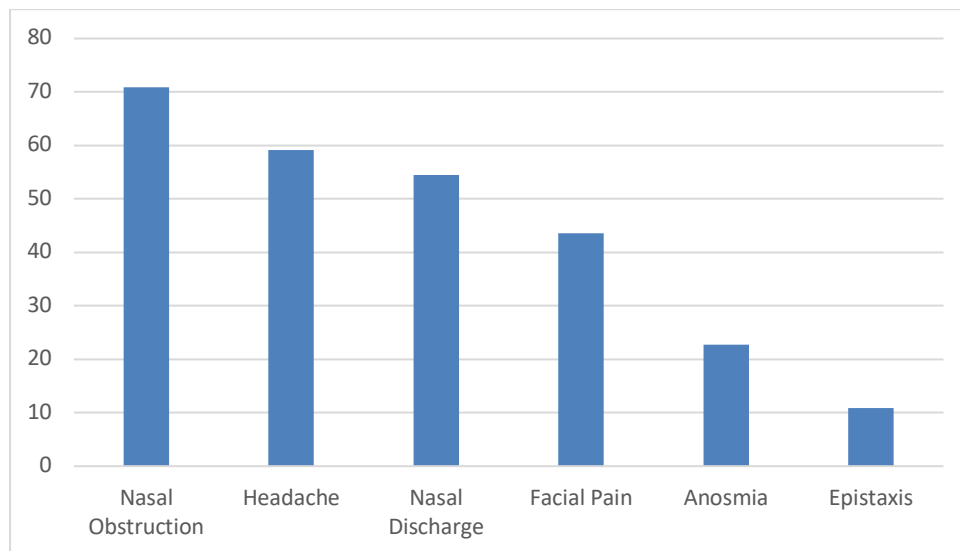


Figure 3: Graphical Representation of the Percentage of Distribution of Presenting Clinical Symptoms

Table 4 illustrates the pattern of sinus involvement determined using CT PNS. Maxillary sinus represented the highest prevalence of sinuses involvement, with 82 occurrences or 74.5% while ethmoidal sinuses showed sinus involvement of 68 cases or 61.8%. Infection of sinuses in frontal sinus

occurred in 40 patients which was 36.4% while sphenoidal sinuses infection occurred in 28 patients which was 25.5%. Hence, it may be deduced from the above results that there are two dominant sites of the disease in the nose which include maxillary and ethmoidal sinuses.

Sinus Involved	Frequency (n)	Percentage (%)
Maxillary Sinus	82	74.5
Ethmoidal Sinus	68	61.8
Frontal Sinus	40	36.4
Sphenoidal Sinus	28	25.5

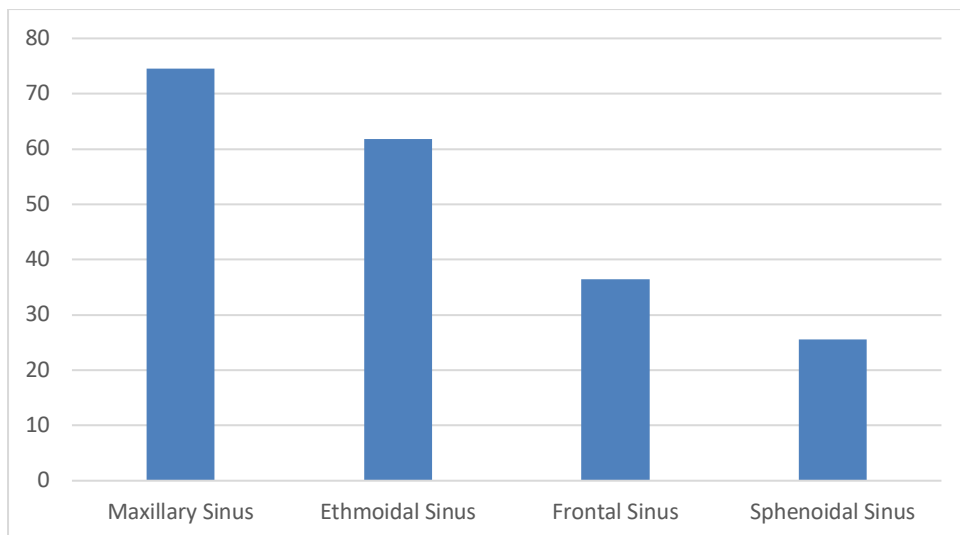


Figure 4: Graphical Representation of the Percentage of Distribution of Sinus Involvement on CT PNS

Table 5 provides a brief summary of all the different radiologic findings noted on CT PNS scans. The most frequently seen among the radiologic abnormalities were thickened mucosa, observed in 85 patients (77.3%); sinus opacification, seen in 72 patients (65.5%); nasal

septal deviation, observed in 58 patients (52.7%); and osteomeatal complex obstruction, seen in 50 patients (45.5%). Some less frequently occurring radiologic abnormalities included nasal polyps in 21.8% of the patients; sinonasal masses, in 10% of the patients; and bone erosions/re-modeling.

Table 5: Distribution of Radiological Findings on CT PNS

Radiological Finding	Frequency (n)	Percentage (%)
Mucosal Thickening	85	77.3
Sinus Opacification	72	65.5
Deviated Nasal Septum	58	52.7
Osteomeatal Complex Obstruction	50	45.5
Concha Bullosa	38	34.5
Nasal Polyps	24	21.8
Air-Fluid Levels	20	18.2
Sinonasal Masses	11	10.0
Bony Erosion/Remodeling	8	7.3

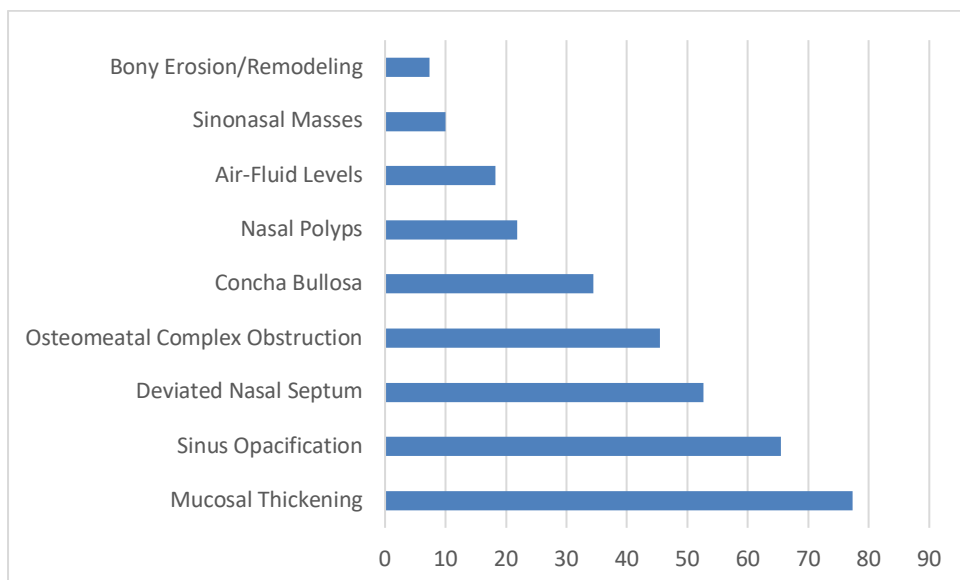


Figure 5: Graphical Representation of the Percentage of Distribution of Radiological Findings on CT PNS

Discussion

The present study assessed the radiological features of the disease conditions in 110 patients suffering from sinonasal diseases on CT PNS. From the demographics, it was apparent that the greatest number of patients belonged to the 31-40 years age group, while the second highest number of patients belonged to the 18-30 years age group (Nepal et al., 2013) [16]. This indicated that sinonasal disorders generally occurred in younger patients. Male predominance was noted in the study sample, as the percentage of male patients accounted for 58.2%. In accordance with other studies, the prevalence of sinonasal disorders was higher in males owing to exposure to environmental hazards (Islam et al., 2013) [17]. The most common clinical signs associated with sinonasal diseases included nasal obstruction (70.9%), headache (59.1%), and nasal discharge (54.5%).

CT PNS showed high sensitivity in determining the extent and pattern of involvement of various sinuses. The most common site of involvement was the maxillary sinus, which had a high percentage of involvement in 74.5% of cases. Ethmoidal sinus, in comparison, was less frequently affected in 61.8% of patients (Turkdogan et al., 2017) [18]. These results can be attributed to the drainage pathways of paranasal sinuses, which made maxillary and ethmoidal sinuses particularly vulnerable to any infection. Chronic rhinosinusitis was the most commonly diagnosed condition based on CT images, which was detected in 47.3% of cases. Acute rhinosinusitis and sinonasal polyposis were the second and third most common disorders, with frequencies of 18.2% and 14.5%, respectively. As observed, inflammatory diseases were common in the present study, indicating the significance of CT for early detection and characterization of sinonasal disorders (Devareddy & Devakar, 2019) [19].

Radiological evaluation of patients showed that mucosal thickening was the most prevalent finding on CT images, with a frequency of 77.3%. Other commonly encountered pathologies include opacification of sinuses (65.5%), nasal septal deviation (52.7%), and obstruction of osteomeatal complex (45.5%). Nasal septal deviation and concha bullosa constituted the most commonly encountered anatomical anomalies in this study with incidences of 52.7% and 34.5%, respectively. Anatomical abnormalities could lead to ventilation problems in various sinuses, leading to development of chronic sinonasal diseases (Yadav et al., 2017) [20]. In addition, statistical significance of correlation between gender and deviated nasal septum ($p = 0.042$) emphasized the clinical significance of anatomic abnormalities associated with sinonasal diseases. Based on the results, it can be concluded that CT PNS was

beneficial in the evaluation of various radiological aspects of sinonasal diseases.

Conclusion

From this study, it can be concluded that CT of the paranasal sinuses plays an important role in the investigation of sinonasal diseases. According to the results, sinonasal pathologies were more common in the younger age groups. In addition, male subjects dominated among those who had various types of sinonasal disease. Nasal obstruction, headache, and nasal discharge were the most frequently occurring complaints. CT was very helpful in determining the presence and degree of sinus involvement. Maxillary and ethmoidal sinuses were the most affected areas in patients. Radiologic abnormalities found in this patient population included mucosal thickening, sinus opacification, deviation of nasal septum, and obstruction of the osteomeatal complex, while chronic rhinosinusitis was found to be the leading diagnosis. Anatomical variations, such as deviation of the nasal septum and concha bullosa, also occurred very often in this patient population and likely played a role in the development of various sinonasal diseases. Therefore, CT of the paranasal sinuses proved to be an invaluable diagnostic tool in assessing various aspects of sinonasal diseases.

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