Section: Miscellaneous

Original Research Article

ROLE OF DNE AND CT OF NOSE AND PARANASAL SINUSES TO DETERMINE ANATOMICAL VARIATIONS IN PATIENTS OF CHRONIC RHINOSINUSITIS WITHOUT SINONASAL POLYPOSIS

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ABSTRACT

Background: Anatomical variations are seen in most patients of chronic rhinosinusitis without sinonasal polyposis, which predispose them for the condition. Diagnostic nasal endoscopy(DNE)and Computed tomography(CT) scan of paranasal sinuses have been used to do preoperative assessment in patients of chronic rhinosinusitis before planning surgery, with CT scan being superior to DNE in assessing the anatomical variations.

Objectives

- To assess the prevalence of structural changes in clinically diagnosed patients with CRS without sinonasal polyposis using diagnostic nasal endoscopy and computed tomography of the nose and paranasal sinuses.
- To examine the significance of pre-operative CT assessment in in clinically diagnosed patients with CRS.
- To determine the various clinical and demographic factors associated with chronic rhinosinusitis.

Materials and Methods: All patients in age group of 18-65 years attending the ENT OPD with CRS for >12 weeks and clinically diagnosed with EPOS- 2020 criteria, who satisfy the inclusion and exclusion criteria and who are willing to participate, were recruited for the study. Patients were then subjected to DNE and findings recorded. All these patients were then evaluated with CT(Plain)scan of paranasal sinuses and findings noted. **Results:** Septal deviation was noted as most common variation (81.1%). Comparative analysis of DNE and CT showed that septal deviation, inferior turbinate hypertrophy and concha bullosa were consistently identified by both DNE and CT. Certain variations like haller cells, onodi cells, sinus opacifications, sphenoid sinus pneumatisation, lamina papyracea morphology were identified by CT alone. **Conclusion:** While DNE offers realtime visualization of nasal cavity and is effective in assessing mucosal abnormalities, CT excels in providing detailed imaging of deeper anatomical structures and variations.

INTRODUCTION

Chronic Rhinosinusitis (CRS) is defined as inflammatory and infectious disorders impacting the nose and paranasal sinuses for a duration beyond twelve weeks.[1]

The OMC, responsible for emptying the anterior sinuses, is a crucial element in the pathogenesis of CRS.[1,2] Anatomical variation that further compromises this critical region may elevate the patient's susceptibility to infection, recurrent infections, and chronic inflammatory changes in the mucosa. The hazards may be exacerbated if the patient has an infection. The CRS is marked by enduring repercussions and severe symptoms, leading to diminished workplace productivity, reduced quality of life, and considerable financial hardships.[3]

Otorhinolaryngology clinics in most parts of the world, affecting patients of all ages and gender. It is a common, chronic inflammatory disease of paranasal sinuses. Currently reported prevalence of chronic rhinosinusitis varies substantially with rates ranging from 1.0% to 12.1% across the world.[4]

Chronic rhinosinusitis (CRS) affects 1 in 8 people in India: about 5-15% of urban population.[5]

Chronic inflammation of the nasal and paranasal mucosa, which in turn leads to secondary infection, is the root cause of ostial blockage and secretory retention. The problem is made worse due to the fact that inflammation leads to malfunction in the mucociliary system. A wide range of variables, both local and systemic, have the potential to play a role in the development of chronic rhinosinusitis-related symptoms. Rhinosinusitis often occurs due to nose and paranasal sinus abnormalities. When the patency of drainage at the OMC changes, it might lead to rhinosinusitis.

It is believed that CRS may be triggered by certain nose and paranasal sinus structural changes. These anatomical variations can cause obstruction of the OMC, frontal recess, sphenoethmoidal recess and thereby interfere with mucociliary clearance and drainage of secretions, which allows for chronic rhinosinusitis to occur.

Over the past few decades, both nasal endoscopy and CT have been used successfully as diagnostic modalities for nose and sinus diseases. They help us to determine the mucosal abnormalities and bony anatomic variations of nose and paranasal sinuses and thereby assess the possible pathogenicity. The revolutionary changes in the surgical treatment of rhino sinusitis in recent years, particularly in endoscopic surgery, require the surgeons to have detailed knowledge of the anatomy of the lateral nasal wall, paranasal sinuses and surrounding vital structures and of the large number of anatomical variants in the region, many of which are detectable only by the use of CT.[6] Therefore, a CT scan of the nose and para nasal sinus is essential prior to sinus surgery. This will allow the surgeon to assess the intricate architecture, which will help them avoid issues during and after the procedure. It will also allow them to properly treat the patient to prevent any sequelae or recurrence of the condition.

Till date, not many Indian studies were done on this topic, so hence thought of conducting a study to know the prevalence of anatomical variations in patients of Chronic Rhinosinusitis in our institutional area. Also, there has not been many studies done on anatomical variations like sphenoid sinus pneumatization, morphology of lamina papyracea, anterior ethmoidal notch etc. contributing to the pathogenesis of the disease. Knowing the anatomic variations of the nose and paranasal sinuses in rhinosinusitis patients undergoing treatment/surgery is important because it can be used as a reference for proper intervention to treat rhinosinusitis. Also, with proper pre- operative evaluation of anatomical variations, we can reduce inadvertent complications during surgery and also ensure the complete clearance of the disease. The objectives of the study were to assess the prevalence of structural changes in clinically diagnosed patients with chronic rhinosinusitis without sinonasal polyposis using diagnostic nasal endoscopy and computed tomography of the nose and paranasal sinuses. The study also examined the significance of pre-operative CT assessment in these patients. Additionally, it aimed to determine the various clinical and demographic factors associated with chronic rhinosinusitis.

MATERIALS AND METHODS

The study was conducted during the period from September 2022 to February 2024.

The sample size was based on the prevalence from my reference study done by Rashi Tiwari and Rashmi Goyal, and was calculated as 90.[7]

Inclusion Criteria

- Patients older than 18 years old with chronic rhinosinusitis symptoms for a duration exceeding 12 weeks qualify.

Exclusion Criteria

- Patients aged more than 65 years.
- Patients who were previously operated on nose and paranasal sinuses.
- Patient with congenital facial anomalies.
- Patients not willing for study.
- Patients with history of previous trauma to nose and paranasal sinuses.
- Patients who were COVID-19 positive within past six months.

All patients in age group of 18-65 years attending the ENT OPD with CRS for >12 weeks and clinically diagnosed using EPOS- 2020 criteria, who are willing to participate, were recruited for the study. Informed written consent was obtained from the patients who were willing to participate in the study. Comprehensive assessment was made with reference to name, age, sex, educational status, occupation, annual income, marital status, socioeconomic status, smoking and alcohol consumption, any drug allergy, topical and systemic corticosteroids use, body weight and height, complaints with their duration, treatment history, allergy history, similar illness in family and other associated systemic conditions such as diabetes, hypertension, airway diseases, allergic rhinitis, tuberculosis, immunosuppressive states (HIV, transplant patients, malignancy), autoimmune diseases, psychiatric diseases were recorded. Past history of similar illness was also enquired. General and systemic examination was done.

- History regarding complaints like nasal obstruction, nasal discharge, facial pain, headache, post nasal discharge, smell disturbances, taste disturbances, ear pain/fullness was taken and clinical diagnosis of chronic rhinosinusitis was made according to EPOS-2020 criteria.
- Patients were then subjected to DNE and findings were recorded.
- All these patients were then evaluated with CT (Plain) scan of paranasal sinuses and findings noted.

Ethics approval

The Institutional Ethics Committee approval was obtained before the start of the study.

RESULTS

Table 1: Distribution of the study population based on Age

Age group	Frequency	Percentage
18 – 30	46	51.1%
31 – 40	24	26.7%
41 – 50	14	15.6%
51 – 60	4	4.4%
61 – 65	2	2.2%
Total	90	100%

This table presents the age distribution of the study population. The majority of participants, comprising 51.1%, fall within the 18-30 age range. This is followed by 26.7% in the 31-40 age range, 15.6% in the 41-50 range, 4.4% in the 51-60 range, and finally, 2.2% are aged 61-65. The total number of participants in the study is 90, making up 100% of the study population.

Table 2: Distribution of the study population based on Gender

Gender	Frequency	Percentage
Male	51	56.70%
Female	39	43.30%
Total	90	100%

Out of the total 90 participants, 56.7% are male, and 43.3% are female. This distribution provides insight into the gender composition of the study population.

Table 3: Distribution of study population based on patient characteristics

		Frequency	Percentage
Residence	Urban	67	74.4%
	Rural	23	25.6%
Industrial employment		41	45.6%
BMI	- Normal	72	80%
	Obese	14	15.6%
	Underweight	4	4.4%
Smoking present		36	40%
Alcoholism present		40	44.4%
Drug allergy present		2	2.2%
Total		90	100%

This table categorizes the study population based on various patient characteristics. Most participants reside in urban areas (74.4%), while 25.6% are from rural areas. Regarding industrial employment, 45.6% are employed in the industrial sector. In terms of Body Mass Index (BMI), 80% have a normal BMI, 15.6% are obese, and 4.4% are underweight. Additionally, 40% of the participants smoke, 44.4% consume alcohol, and 2.2% have a drug allergy. The total number of participants remains 90.

Table 4: Distribution of the study population based on symptoms

Symptoms	Frequency	Percentage
Headache	73	81.1%
Facial pain/dental pain	23	25.6%
Nasal obstruction	77	85.6%
Nasal discharge	68	75.6%
Postnasal discharge	54	60%
Epistaxis	4	4.4%
Sneezing	48	53.3%
Smell disturbances	21	23.3%
Taste disturbances	19	21.1%
Halitosis	13	14.4%
Cough	51	56.7%
Fever	28	31.1%
Nausea/vomiting	7	7.8%
Ear pain/fullness	38	42.2%

This table lists the prevalence of various symptoms among the study participants. The most common symptoms include nasal obstruction (85.6%), headache (81.1%), nasal

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discharge (75.6%), and post-nasal discharge (60%). Other symptoms include sneezing (53.3%), cough (56.7%), and facial pain/dental pain (25.6%). Less common symptoms include fever (31.1%), ear pain/fullness (42.2%), smell disturbances (23.3%), and taste disturbances (21.1%). Rare symptoms include halitosis (14.4%) and epistaxis (4.4%).

Table 5: Distribution of the study population based on signs

		Frequency	Percentage
Nasal mucosa	Congested	24	26.7%
	Pale	18	20.0%
	Normal	36	40.0%
	Edematous	12	13.3%
Nasal discharge	Mucoid	18	20.0%
	Purulent	23	25.6%
	Mucopurulent	29	32.2%
Inferior turbinate	Hypertrophy	57	63.3%
	Normal	37	41.1%
Middle turbinate	Concha bullosa	9	10.0%
	Normal	70	77.8%
	Paradoxical	3	3.3%
	Double	4	4.4%
Middle meatus	Normal	27	30.0%
	Discharge	51	56.7%
	Narrow	12	13.3%
Sinus tenderness	Maxillary	29	32.2%
	Frontal	17	18.9%
	Ethmoid	21	23.3%
Posterior pharyngeal wall discharge		11	12.2%
Granular		31	34.4%
Deviated nasal septum		73	81.1%

This table examines the physical signs observed in the study population. The most common variation observed is deviated nasal septum in 81.1%participants. Inferior turbinate hypertrophy is seen in 63.3%participants. The nasal mucosa appears congested in 26.7% of participants, pale in 20%, normal in 40%, and edematous in 13.3%. Twenty percent of patients have mucoid discharge, twenty-five percent purulent discharge, and thirty-two percent mucopurulent discharge from their noses. A total of 63.3% of individuals show signs of inferior turbinate hypertrophy.

The middle turbinate presents as concha bullosa in 10%, paradoxical in 3.3%, and double in 4.4%. Middle meatus discharge is seen in 56.7% and posterior pharyngeal wall discharge seen in 12.2% participants. Among sinus tenderness, maxillary sinus tenderness was observed highest in 32.2% of participants.

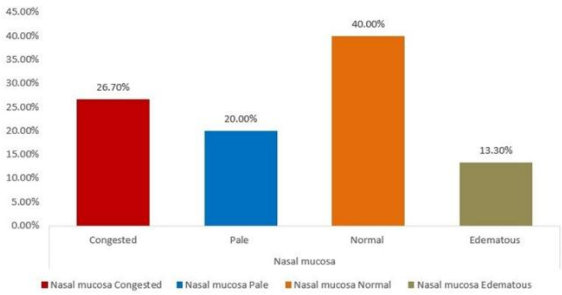

Figure 1: Findings in nasal mucosa

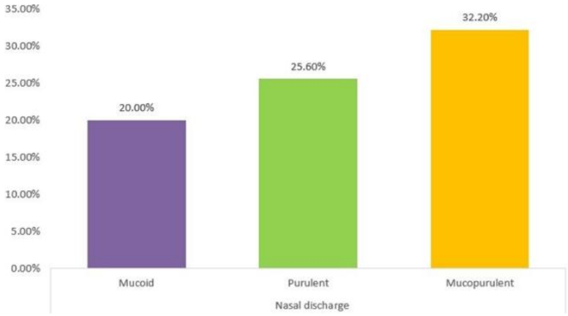

Figure 2: Types of nasal discharge

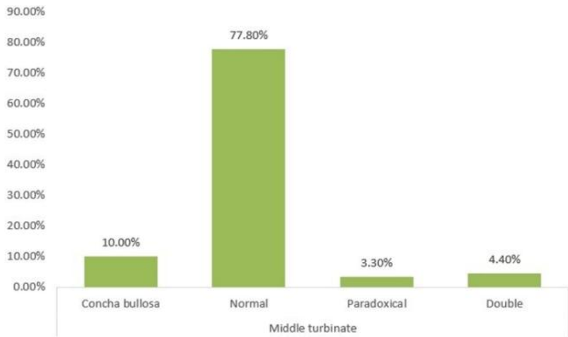

Figure 3: Variations in middle turbinate

Table 6 a,b,c: Comparative findings in CT and DNE of nasal cavity

	Diagnostic nasal endoscopy			Computed Tomography Findings		
	Right	Left	B/L	Right	Left	B/L

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Septal deviation	40	33	0	40	33	0
Inferior turbinate hypertrophy	27	30	4	27	30	4
Middle turbinate– concha bullosa	4	5	2	11	13	6
Paradoxical	2	1	1	13	7	4
Double	2	2	0	3	4	0
Prominent Bulla ethmoidalis	0	0	0	9	8	3
Prominent Aggernasi cell	7	5	1	18	15	6
Pneumatised uncinate	5	2	2	8	4	4
Maxillary accessory ostium	2	1	0	4	2	0
Haller or Infraorbital cells	0	0	0	5	3	2
Onodi or sphenoethmoidal cells	0	0	0	2	3	2
Frontal cell	0	0	0	9	7	3
Maxillary sinus opacification	0	0	0	16	10	18
Anterior ethmoid sinus Opacification	0	0	0	6	8	15
Posterior ethmoid sinus Opacification	0	0	0	2	1	12
Frontal sinus opacification	0	0	0	12	10	9
Sphenoid sinus opacification	0	0	0	8	6	10
Sphenoid sinus pneumatisation – Conchal	0	0	0	1	1	1
Pre-sellar	0	0	0	83	83	83
Sellar				6	6	6
Lamina papyracea morphology – TypeA	0	0	0	89	89	89
TypeB	0	0	0	1	1	1
TypeC	0	0	0	0	0	0
Abnormal anterior ethmoidal notch	0	0	0	0	0	0
Uncinate process attachment– Type I	0	0	0	89	89	89
Type II	0	0	0	1	1	1
Type III	0	0	0	0	0	0
Type IV	0	0	0	0	0	0
Type V	0	0	0	0	0	0
Type VI	0	0	0	0	0	0
Optic nerve relation– Type I	0	0	0	88	88	88
Type II	0	0	0	2	2	2
Type III	0	0	0	0	0	0
Type IV	0	0	0	0	0	0
Olfactory fossa depth(KERO's)- Type I	0	0	0	3	3	3

This table compares diagnostic nasal endoscopy (DNE) findings with computed tomography (CT) findings for various conditions. Septal deviation is observed on the right in 40 cases and on the left in 33 cases. Inferior turbinate hypertrophy is seen on the right in 27 cases, on the left in 30 cases, and bilaterally in 4 cases.

Concha bullosa of the middle turbinate is noted more frequently in CT findings compared to DNE. Other anatomical variations such as paradoxical and double middle turbinates, prominent bulla ethmoidalis, and agger nasi cells are also compared, highlighting differences between DNE and CT findings.

This table further explores anatomical variations between DNE and CT findings.

Pneumatized uncinate is identified more frequently in CT findings. Maxillary accessory ostium, Haller cells, and Onodi cells are noted exclusively in CT.

Maxillary sinus opacification and other sinus opacifications are significantly more frequent in CT findings. Variations such as sphenoid sinus pneumatization and lamina papyracea morphology are also described, with CT revealing a broader spectrum of anatomical differences compared to DNE. Additionally, the depth of the olfactory fossa according to KERO's classification and the optic nerve relation are more comprehensively detailed in CT findings.

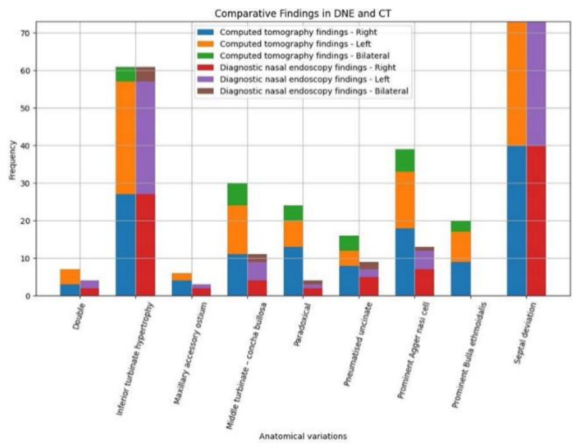

Figure 4: Comparative findings in DNE and CT

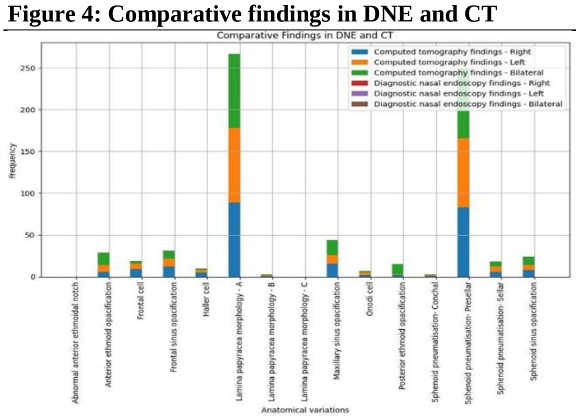

Figure 5: Comparative findings in DNE and CT

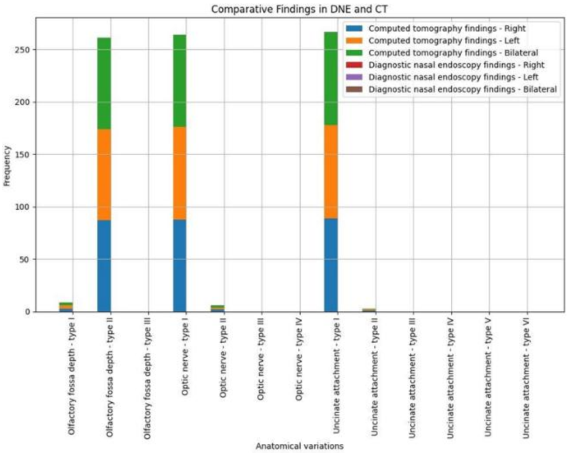

Figure 6: Comparative findings in DNE and CT

DISCUSSION

Age distribution

The study population tended to cluster around younger age groups, according to the age distribution. In particular, 51.1% were in the 18–30 age bracket, with 26.7% being in the 31–40 age bracket. It seems that younger participants were more likely to engage in the research or were more motivated to do so. The participants' average age was 41.6, suggesting a moderate representation of middle-aged people. The representation sharply declined for older age groups, with 4.4% of participants aged 51-60 years and only 2.2% aged 61-65 years. The total number of participants was 90, providing a comprehensive snapshot of the age distribution within the study cohort.

The age distribution in our study highlights several critical points. First, the predominance of younger adults (18-30 years) aligns with findings from similar studies, suggesting that this age group is more likely to seek medical consultation and participate in research.

A study by Pullarat et al,[8] (2018) reported a mean age of 33.7 years among their participants, reflecting a similar trend of younger individuals being more prevalent in clinical settings for chronic conditions like rhinosinusitis. This demographic trend may be attributed to greater health awareness, accessibility to healthcare services, and higher rates of urbanization among younger adults.

The lower representation of older age groups could be due to several factors. Older adults might have less access to health care services, be less inclined to participate in studies, or have different health priorities. Additionally, older populations may suffer from comorbidities that exclude them from participating in specific clinical studies. This trend is consistent with findings in other studies where older age groups are less represented. For example, comparable explanations may account for the increased proportion of younger people in the cohort of Lohiya et al. (2015).[9]

The age distribution data from our study provide valuable insights for healthcare providers and researchers. It underscores the need to tailor healthcare services and research initiatives to the demographics most likely to seek treatment and participate in studies. Moreover, it highlights potential gaps in healthcare access or willingness to participate among older adults, suggesting areas for further investigation and intervention.

Gender distribution

The gender distribution in our study revealed a slight male predominance. Out of the 90 participants, 56.7% were male, while 43.3% were female. This gender distribution provides an important perspective on the study population's demographic characteristics, reflecting a higher engagement or prevalence of the condition under investigation among males.

This finding is consistent with several other studies in the field. For example, Pullarat et al,[8] (2018) found a similar gender distribution in their study on chronic rhinosinusitis, with 58% of their participants being male. This trend may be reflective of the general healthcare-seeking behaviour, where males are

more likely to seek treatment for certain conditions, or it could indicate a higher incidence of the condition among males.

Another study by Lohiya et al,[9] (2015) also reported a male predominance in their cohort, with 52% of their participants being male. The reasons for this male predominance could be multifactorial, including genetic, hormonal, or environmental factors that predispose men to higher incidences of certain conditions. Additionally, social factors such as employment in more hazardous occupations, which are typicallymale-dominated, could contribute to this trend.

The female representation in our study, while lower than males, is still significant at 43.3%. This indicates that the condition or factors under study are also prevalent among women, warranting targeted healthcare strategies for both genders. The slightly lower participation of females might also reflect societal factors such as lower healthcare access or priorities, especially in certain regions or demographics.

Understanding the gender distribution is crucial for designing effective intervention strategies. It suggests the need for gender-specific health education and intervention programs. For instance, healthcare campaigns could be tailored to address the specific needs and behaviours of men and women to improve health outcomes. Moreover, recognizing the gender disparity can help in understanding the underlying causes and developing more comprehensive healthcare policies that ensure equitable access and treatment for both genders.

Patient characteristics

Our study population's characteristics provide a detailed understanding of the demographic and lifestyle factors that may influence health outcomes. The majority of participants resided in urban areas (74.4%), with only 25.6% from rural areas. This

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urban predominance aligns with global trends where urban populations have better access to healthcare services and are more likely to participate in health-related studies. This is supported by findings from the study by Aramani et al,[10] (2014), which also highlighted a higher urban participation in similar research contexts.
Industrial employment was noted in 45.6% of the participants, indicating a significant proportion engaged in occupations that might expose them to specific health risks. Thisaligns with the findings of Lohiya et al,[9] (2015), who noted that occupational factors often contribute to the prevalence of certain health conditions.
Regarding Body Mass Index (BMI), 80% of the participants were within the normal range, 15.6% were obese, and 4.4% were underweight. This distribution suggests a relatively healthy BMI profile for the majority, although the presence of obesity highlights a need for targeted health interventions. Similar BMI distributions were observed in the study by Pullarat et al,[8] (2018), reflecting broader trends in population health.
Lifestyle factors such as smoking and alcoholism were prevalent in 40% and 44.4% of participants, respectively. These high percentages indicate significant lifestyle-related health risks. The presence of drug allergies was minimal at 2.2%.
Understanding these characteristics is vital for developing effective public health strategies. The urban predominance suggests the need for accessible healthcare services in rural areas. The high rates of smoking and alcohol use underscore the importance of lifestyle modification programs. Moreover, recognizing the occupational risks associated with industrial employment can guide workplace health and safety regulations.
In conclusion, the demographic and lifestyle characteristics of our study population provide a comprehensive overview that can inform targeted health interventions. By addressing the specific needs highlighted by these characteristics, healthcare providers can develop more effective strategies to improve health outcomes for diverse populations.

Symptoms

The distribution of symptoms among our study population reveals critical insights into the prevalent health issues and their severity. Nasal obstruction was the most common symptom, reported by 85.6% of participants, followed by headaches (81.1%), nasal discharge (75.6%), and post-nasal discharge (60%). These symptoms are indicative of chronic rhinosinusitis (CRS) and align with findings from other studies in this field.
The most prevalent symptoms among the study population were headaches and nasal obstruction, as stated by Pullarat et al,[8] (2018). The substantial influence of CRS on patients' quality of life is shown by the high incidence of these symptoms, which calls for improved diagnostic and treatment approaches.
Additional symptoms such as sneezing (53.3%), cough (56.7%), and ear pain/fullness (42.2%) were also prevalent. These symptoms further complicate the clinical picture, as they can overlap with other respiratory conditions. The presence of smell disturbances (23.3%) and taste disturbances (21.1%) highlights the sensory impact of CRS, affecting daily activities and overall well-being.
The study by Lohiya et al,[9] (2015) found a similar symptom profile, with nasal obstruction, discharge, and headache being the most common complaints among their patients . This consistency across studies emphasizes the need for healthcare providers to be vigilant in recognizing and managing these symptoms to alleviate patient discomfort.
Less common symptoms in our study included halitosis (14.4%), epistaxis (4.4%), and nausea/vomiting (7.8%). While these symptoms were less frequently reported, their presence can indicate more severe or complicated cases of CRS, requiring thorough evaluation and management.
The comprehensive symptom distribution in our study highlights the multifaceted nature of CRS and its widespread impact on patients. Effective management requires aholistic approach that addresses all prevalent symptoms.
This may involve a combination of medical treatment, lifestyle modifications, and possibly surgical interventions for severe cases.
In conclusion, the symptom profile of our study population provides valuable insights into the burden of CRS. By understanding the prevalence and impact of these symptoms, healthcare providers can develop more targeted and effective treatment strategies to improve patient outcomes.

Signs

The distribution of physical signs observed in our study population provides critical insights into the clinical presentation of chronic rhinosinusitis (CRS). Nasal mucosa was found to be congested in 26.7% of participants, pale in 20%, normal in 40%, and edematous in 13.3%. These findings align with the typical presentation of CRS, where inflammation and congestion of the nasal mucosa are common.
Nasal discharge characteristics varied, with 20% of participants having mucoid discharge, 25.6% purulent discharge, and 32.2% mucopurulent discharge.
These findings are consistent with those reported by Pullarat et al,[8] (2018), who also noted a high prevalence of purulent and mucopurulent discharge among CRS patients. The type of discharge provides important diagnostic clues and can guide the choice of treatment, including the need for antibiotics.
Inferior turbinate hypertrophy was observed in 63.3% of participants, a common findingin CRS that can contribute to nasal obstruction. The middle turbinate was normal in 77.8% of participants, with concha bullosa observed in 10%, paradoxical turbinate in 3.3%, and double middle turbinate in 4.4%. These anatomical variations can impact sinus drainage and airflow, exacerbating CRS symptoms. Similar findings were reported by Lohiya et al,[9] (2015), who noted a significant prevalence of turbinate

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hypertrophy and other anatomical variations in their study population.
Sinus tenderness was also evaluated, with maxillary sinus tenderness present in 32.2% of participants, frontal sinus tenderness in 18.9%, and ethmoid sinus tenderness in 23.3%. These findings indicate the involvement of multiple sinus cavities in CRS, which is a key factor in determining the extent and severity of the disease.
Deviated nasal septum was observed in 81.1% of participants, a common anatomical variation that can contribute to CRS by obstructing nasal airflow and sinus drainage. This high prevalence is consistent with findings from other studies, such as those by Aramani et al,[10] (2014), who also reported a significant incidence of septal deviationin their study population.
The comprehensive assessment of physical signs in our study highlights the complex clinical presentation of CRS. These findings emphasize the importance of a thorough clinical examination in diagnosing CRS and determining the appropriate treatment strategy. By addressing both the inflammatory and anatomical components of the disease, healthcare providers can improve patient outcomes and quality of life.

Comparative findings in CT and DNE of nasal cavity:

In our study, the comparative analysis of diagnostic nasal endoscopy (DNE) and computed tomography (CT) findings for the nasal cavity revealed important diagnosticinsights. Both DNE and CT were consistent in detecting septal deviation, with 40 caseson the right and 33 on the left side. This consistency underscores the reliability of both methods in identifying septal deviation, a key factor in chronic rhinosinusitis (CRS).
Inferior turbinate hypertrophy was equally observed by both methods, with 27 cases on the right, 30 on the left, and 4 bilateral cases. The agreement between DNE and CT in detecting turbinate hypertrophy highlights the complementary role of these diagnostic tools. However, middle turbinate concha bullosa was noted more frequently in CT findings (right: 11, left: 13, bilateral: 6) compared to DNE (right: 4, left: 5, bilateral: 2), indicating CT's superior sensitivity in identifying this anatomical variation.
Paradoxical middle turbinate and double middle turbinate were also more frequently identified in CT scans. For instance, paradoxical turbinate was observed in 13 right cases, 7 left cases, and 4 bilateral cases on CT, while DNE detected fewer instances. This trend was also seen with double middle turbinate, with CT identifying 3 right cases and 4 left cases, compared to fewer detections by DNE.
Prominent bulla ethmoidalis and agger nasi cell were more frequently identified in CTscans. CT detected prominent bulla ethmoidalis in 9 right cases, 8 left cases, and 3 bilateral cases, while DNE found none. Similarly, agger nasi cell prominence was observed m7ore in CT (right: 18, left: 15, bilateral: 6) than in DNE (right: 7, left: 5, bilateral: 1).
Comparative studies, such as those by Pullarat et al,[8] (2018) also highlight CT's superior diagnostic capability in identifying anatomical variations and sinus conditions compared to DNE. The findings from our study are consistent with these reports, reinforcing the complementary roles of DNE and CT in diagnosing CRS.
Overall, the comparative findings from our study emphasize the importance of using both DNE and CT for a comprehensive evaluation of CRS. While DNE provides valuable real-time visualization of the nasal cavity, CT offers a more detailed assessment of anatomical variations and sinus patency. This combined approach enhances diagnostic accuracy and informs more effective treatment strategies for CRS.
The comparative analysis of anatomical variations in our study, using both diagnostic nasal endoscopy (DNE) and computed tomography (CT), provides valuable insights into their diagnostic capabilities. Pneumatized uncinate was identified more frequently in CT (right: 8, left: 4, bilateral: 4) compared to DNE (right: 5, left: 2, bilateral: 2), highlighting CT's superior sensitivity in detecting this variation.
Maxillary accessory ostium was detected by DNE on the right in 2 cases and left in 1 case, whereas CT findings were higher with 4 cases on the right, 2 on the left, and none bilaterally. Haller or infraorbital cells, not identified by DNE, were detected in CT scans (right: 5, left: 3, bilateral: 2), reinforcing CT's role in visualizing these less accessible anatomical features.
Onodi or sphenoethmoidal cells were absent in DNE findings but identified in CT (right:2, left: 3, bilateral: 2), reflecting CT's advantage in detecting deep-seated anatomical variations. Similarly, frontal cells were not observed in DNE but were present in CT findings (right: 9, left: 7, bilateral: 3), again demonstrating CT's detailed imaging capabilities.
Sinus opacification findings were significantly more prevalent in CT.
Maxillary sinus opacification was observed in CT (right: 16, left: 10, bilateral: 18), while DNE did not detect any cases. Anterior ethmoid sinus opacification was also higher in CT (right: 6, left: 8, bilateral: 15), with similar trends for posterior ethmoid (CT right: 2, left: 1, bilateral: 12), frontal (CT right: 12, left: 10, bilateral: 9), and sphenoid sinuses (CT right:8, left: 6, bilateral: 10).
These findings align with studies by Aramani et al,[10] (2014) and Lohiya et al.(9)(2015), which reported higher detection rates of anatomical variations and sinus opacification using CT compared to DNE. The discrepancies in detection rates underscore the limitations of DNE in visualizing deeper and more complex anatomicalstructures, which CT can readily identify.
Unlike other anatomical variations which were both detected by DNE and CT, certain variations like haller cells, onodi cells, frontal cells, sinus opacifications, sphenoid sinus pneumatisation, lamina papyracea morphology, uncinate process

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superior attachment and abnormal anterior ethmoidal notch were able to be picked up by CT alone in our study.

Our study's findings emphasize the complementary nature of DNE and CT.

While DNE provides immediate visual assessment and is useful for identifying mucosal conditions and surface abnormalities, CT excels in detailed imaging of deeper anatomical structures and variations. This combination is crucial for a comprehensive diagnosis and effective management of chronic rhinosinusitis (CRS). In conclusion, the comparative findings from our study underscore the importance of integrating both DNE and CT in the diagnostic process for CRS. A strong foundation for precise diagnosis and individualized treatment plans is established by combining CT's greater sensitivity in identifying anatomical differences and sinus opacification with DNE's real-time visualization. This integrated approach can significantly enhance patient outcomes by ensuring that all relevant anatomical and pathological factors are considered in the management of CRS.

CONCLUSION

The study emphasises the complementary roles of diagnostic nasal endoscopy

(DNE) and computed tomography (CT) in diagnosing and evaluating chronic rhinosinusitis (CRS). While DNE offers valuable real-time visualization of the nasal cavity and is effective in assessing mucosal conditions and surface abnormalities, CT excels in providing detailed imaging of deeper anatomical structures and variations.

Integrated Diagnostic Approach

The combined use of DNE and CT is recommended for a comprehensive evaluation of CRS, as each modality has distinct advantages that contribute to a more accurate diagnosis.

Enhanced Diagnostic Accuracy

The integration of DNE's real-time assessment capabilities with CT's ability to detect profound structural alterations and sinus opacifications improves diagnostic precision and informs treatment alternatives more effectively.

Targeted Treatment Strategies

Healthcare practitioners may improve patient outcomes and quality of life by formulating tailored treatment plans informed by the prevalence and importance of symptoms, physical signs, and structural differences.

In conclusion, this study highlights the necessity of employing both DNE and CT in the diagnostic process for CRS, advocating for a holistic approach that leverages the strengths of both modalities to enhance patient care and treatment efficacy.

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