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"Deciphering The Enigma Of Nasal & Paranasal Anatomy Through Computed Tomography (CT) Imaging"

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Abstract:
Introduction: *the paranasal sinuses are mucosa-lined structures physically contiguous with the nasal cavity that aid in insulation, reducing cranial weight, heating & humidifying the air, imparting resonance to the voice, providing airway defense and simply to replace functionless bone. Sinusitis is rarely life threatening, but the complex anatomy of the facial planes, the associated venous and lymphatic spread and the close location to the central nervous system can lead on to serious complications. It is, therefore, important to understand the normal anatomy of the paranasal sinuses in order to understand the pathogenesis of sinus disease. Hence, the aim of the present study was deciphering the role of ct as the investigation of choice for the preoperative evaluation of the nose & paranasal sinuses and for delineation of obstructive inflammatory sinus disease to aid in the diagnosis and management of recurrent & chronic disease and to define the bony anatomy before surgery.*
Materials and methods: *prospective cross-sectional study was conducted on 100 asymptomatic patients who were getting investigated by computed tomography for non-sinus indications in whom the paranasal sinus region could be included in the field of study referred to department of radio-diagnosis and imaging from indoor and outdoor departments of jan sewa hospital of dr. S. S. Tantia medical college, sri ganganagar.*
Results: *the majority of patients were in the age group of 21-40 years (42.3%) with 70% being male. Patients in the age group equaling or more than 61 years & with diabetes had the most number of incidental findings (68.2 %) agger nasi was the commonest anatomical paranasal sinus variant (82.9 %) followed by concha bullosa (39.3 %), deviation of the nasal septum (35.4 %), onodi cells (12.2 %) & haller cells (11.8 %). Incidental paranasal sinus abnormality in the form of mucosal thickening, sinus secretions or polyps were detected in 51.9 % patients, mucosal thickening being most common (40.1 %) followed by secretions (31.9 %) and mucosal polyps (3.0 %). Incidental paranasal abnormalities were most commonly noted in the ethmoid sinuses (36.7 %) followed by the maxillary sinuses, sphenoid sinuses and then frontal sinuses in descending order of involvement.*
Conclusion: *computed tomography (ct) provides a "road map" for diagnosis and management of recurrent & chronic paranasal sinus disease and to delineate the bony anatomy before sinus surgery and to get an insight into anatomical variants apropos of their clinical relevance & impact on sinus disease.*
Key-words: *Para-nasal sinuses (PNS), computed tomography (CT), enigma, anatomical variants*

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I. Introduction:

The paranasal sinuses are mucosa-lined structures physically contiguous with the nasal cavity. They were first described by Leonardo da Vinci in the publication "Two Views of the Skull." Since his description, numerous theories have been espoused on the anatomical or physiologic importance of the sinuses in humans. These include insulation, reducing cranial weight, heating and humidifying the air, imparting resonance to the voice, providing airway defense and simply to replace functionless bone. Despite the proliferation of theories, their functional role remains an enigma, even prompting some authors to argue that they have proved much more of a liability than an asset. [1] However, sinusitis continues to be one of the most prevalent disorders encountered in general medicine practice [2] as well as in the otorhinololaryngology department.

Sinusitis is rarely life threatening, but the complex anatomy of the facial planes, the associated venous and lymphatic spread and the close location to the central nervous system can lead on to serious complications. It is, therefore, important to understand the normal anatomy of the paranasal sinuses in order to understand the pathogenesis of sinus disease. There are four pairs of sinuses named for the bones of the skull they pneumatize. They are the maxillary, ethmoid, frontal, and sphenoid sinus. The osteomeatal complex encompasses the frontal

recess, ethmoid infundibulum, hiatus semilunaris and middle meatus. It constitutes the common drainage pathway of the frontal, maxillary, and anterior ethmoid air cells and patency of the osteomeatal complex is critical for normal sinus drainage and ventilation.[3] Numerous pathological processes including allergy, viral infections and pollutants cause sinonasal mucosal inflammation leading to occlusion of the ostiomeatal complex. [4] Mucosal swelling impairs mucociliary clearance and results in sinus ostia obstruction. Sinus excretions then pool and thicken, creating a nidus for superinfection.

Conventional radiography has been mostly superceded by CT as the investigation of choice for evaluation of the paranasal sinuses. Hence, the aim of the present study was deciphering the role of CT as the investigation of choice for the preoperative evaluation of the nose & paranasal sinuses and for delineation of obstructive inflammatory sinus disease. [5] The primary role of CT is to aid in the diagnosis and management of recurrent and chronic disease and to define the bony anatomy before surgery. Sinus disease usually manifests with air–fluid levels, mucosal thickening or opacification of the normally aerated sinus lumen. Acute sinusitis may present with isolated air fluid level while presence of sclerotic, thickened sinus wall supports a diagnosis of chronic sinusitis [6]

Anatomical variants in the para nasal sinus region are another area where there is still a lack of consensus among clinicians as regards to their clinical relevance and impact on sinus disease. The variants commonly seen include agger nasi, concha bullosa, haller cells, paradoxical middle turbinate, and onodi cells. During our study we came across all of these variants as well as some rarer ones including vomeral pneumatisation and turbinate sinus.

In this study, we evaluated the CT findings in the paranasal sinus region in 100 patients who presented for non-sinus related indications. A significant percentage of these asymptomatic patients were noted to have incidental sinus abnormalities. A statistical comparison was done comparing our study with similar studies done in various other countries. We also noted prevalence of various anatomical variants and tried to find an association between incidental sinus abnormalities and presence of anatomical variants.

II. Aims And Objectives

- To decipher the role of CT as the investigation of choice for the preoperative evaluation of the nose & paranasal sinuses
- To delineate causes of obstructive inflammatory sinus disease to aid in the diagnosis and management of recurrent and chronic diseases
- To study the prevalence of various paranasal anatomical variants and find an association between incidental sinus abnormalities and presence of anatomical variants

III. Materials And Methods

Prospective cross-sectional study was conducted on 100 asymptomatic patients who were getting investigated by computed tomography for non-sinus indications in whom the paranasal sinus region could be included in the field of study referred to Department of Radio-Diagnosis and Imaging from indoor and outdoor departments of Jan Sewa Hospital of Dr. S. S. Tantia Medical College, Sri Ganganagar. An exclusion criteria was maintained to ensure that these patients did not have any symptoms of sinus disease or any relevant history suggestive of predisposition to sinus disease.

Patients who had a history of any of the following symptoms were excluded from the asymptomatic group - 1. Recurrent or chronic headache 2. Facial pain 3.Nasal drainage (anterior rhinorrhea or post nasal drip) 4.Nasal congestion 5.Dysosmia 6. Chronic low grade fever. We also excluded all patients who were being investigated for trauma, patients who gave history of recent or old trauma near the region of the paranasal sinuses and also all patients in altered sensorium who were unable to provide a reliable history for the symptoms mentioned above.

All the scans were done on the GE SPIRAL (HELICAL) HISPEED & HITACHI SUPRIA MULTI-SLICE CT scanner in Department of Radio-Diagnosis and Imaging of our hospital. The results of study were systematically collected, assimilated and analyzed to draw valid conclusions.

IV. Results & Discussion

The present study "**DECIPHERING THE ENIGMA OF NASAL & PARANASAL ANATOMY THROUGH COMPUTED TOMOGRAPHY (CT) IMAGING"** was conducted on 100 asymptomatic patients who got investigated by computed tomography for non-sinus indications in whom the paranasal sinus region could be included in the field of study, referred to Department of Radio-Diagnosis and Imaging from indoor and outdoor departments of Jan Sewa Hospital of Dr. S. S. Tantia Medical College, Sri Ganganagar. The results were tabulated & categorically arranged and statistical analysis was carried out.

The majority of patients were in the age group of 21-40 years (42.3%) with 70% being male. Patients in the age group equaling or more than 61 years & with diabetes mellitus had the most number of incidental findings (77 %)

Agger nasi was the commonest anatomical paranasal sinus variant (82.9 %) followed by concha bullosa (39.3 %), deviation of the nasal septum (35.4 %), Onodi cells (12.2 %) & Haller cells (11.8 %) ethmoid bulla (4.4 %) , paradoxical middle turbinate (3.9 %) , pneumatisation of the vomeral bone (1.3 %) , hypertrophy of inferior turbinate (1.3 %) , hypoplastic frontal sinus (0.4 %) and sinus turbinate (0.4 %). These findings very well corresponds to the previous studies done by Maru and Gupta [7] who observed agger nasi in 88.5% of their study population, Nitinavankarn et al [8] reporting concha bullosa as being present in 34.1 % of the study group, Dua et al [9] in their study on chronic sinusitis, reporting DNS present in 44 % of the patients and Jones et al [10] who observed Haller cells and Onodi cells in approximately 12 % of their study population.

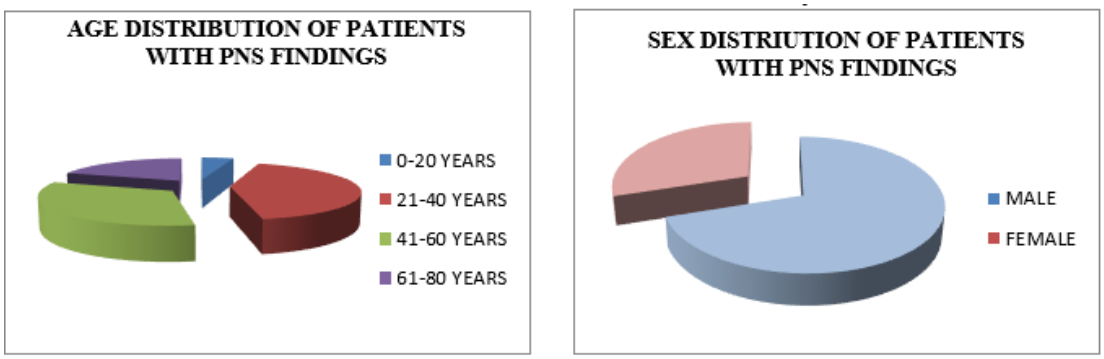
Incidental paranasal sinus abnormality in the form of mucosal thickening, sinus secretions or polyps were detected in 51.9 % patients, This was higher than Lloyd et al [11] who had found incidental sinus findings in 30 % of the study group or Havaz et al [12] who observed them in 42.5 % of their study group.

Mucosal thickening was the most common abnormal pattern seen in the patients who had incidental findings in the paranasal sinuses in this study (36.5 %). Havaz et al [12] had also reported mucosal thickening to be the most common incidental finding in the paranasal sinuses.

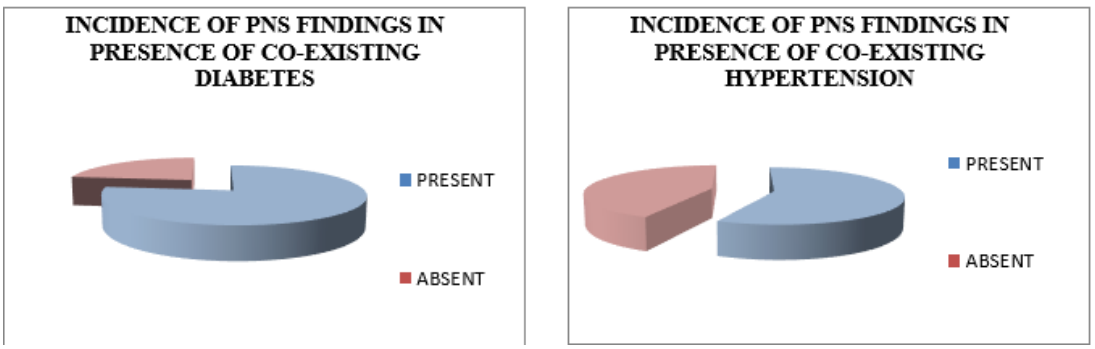
Sinus secretions were identified in 21.4 % subjects followed by mucosal polyps in 3 % subjects. This was lower than Havaz et al [12] who had reported polyps in 7.4 % of their study group.

In our study, 71.4 % patients had polyps involving the maxillary sinuses followed by the involvement of ethmoid and sphenoid sinus. This distribution pattern closely correlates with the study done by Havaz et al [12] who had reported 79.6 % of the incidental polyps in his study as being present in the maxillary sinus.

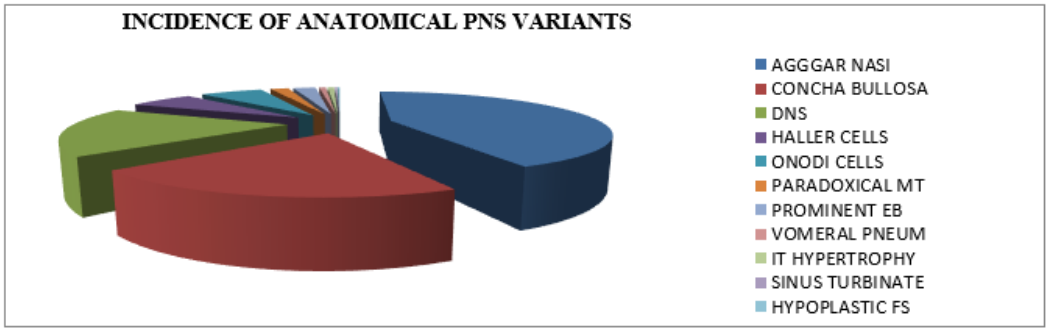
In terms of distribution, the ethmoid sinuses were found to be the most commonly affected among the patients who demonstrated mucosal thickening or secretions. This pattern corresponded to both Havaz et al [12] and Lloyd et al [11] The ethmoid sinuses were found to be involved in 43.5 % patients followed by maxillary sinuses (26.4 %), sphenoid sinuses (23.3 %) and frontal sinuses (6.8 %). The distribution as reported by Havaz et al [12] was ethmoid sinuses (28.4 %), maxillary sinuses (24.8 %), sphenoid sinuses (9.5 %) and frontal sinuses (4.6 %) in descending order of involvement. Maxillary and ethmoid sinuses were the two most commonly affected sinuses and between them accounted for 72.2 % of the abnormal sinuses in the study.



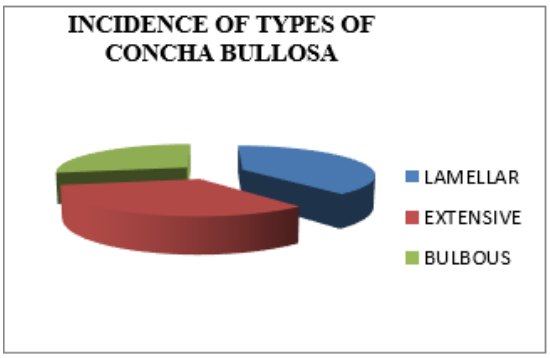
Bar Diagrams Showing Age Distribution And Sex Distribution Of Patients With Paranasal Sinus Findings

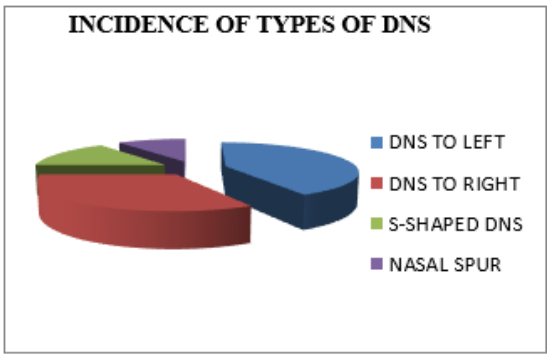


Bar Diagrams Showing Incidence Of Pns Findings In Presence Of Co-Existing Diabetes And Hypertension

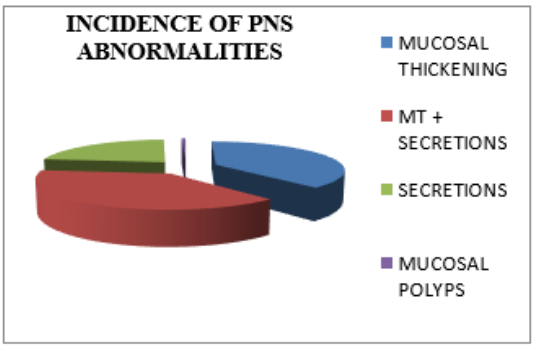


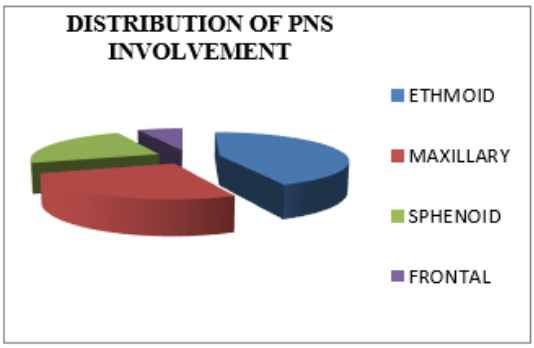
Bar Diagram Showing Distribution Of Patients With Anatomical Pns Variants



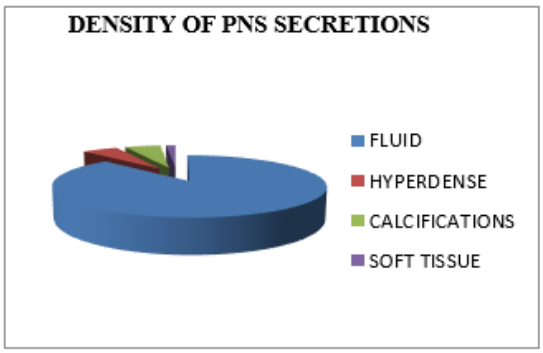


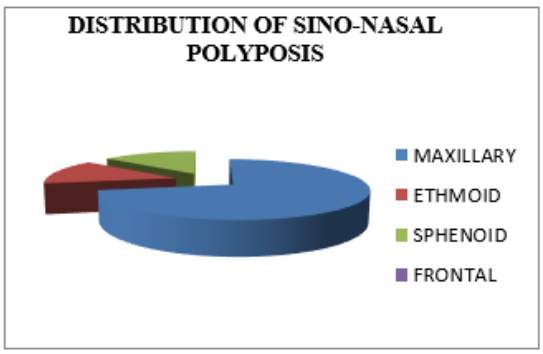
Bar Diagrams Showing Distribution Of Patients With Types Of Concha Bullosa And Dns





BAR DIAGRAMS SHOWING INCIDENCE OF PNS ABNORMALITIES AND PNS INVOLVEMENT

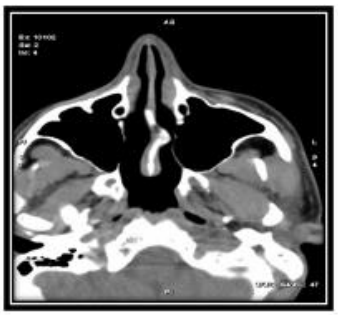




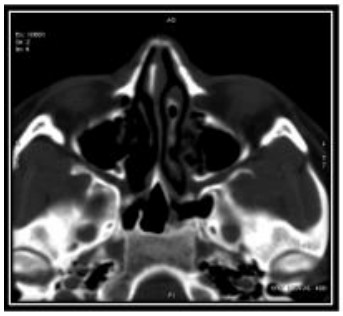
BAR DIAGRAMS SHOWING DENSITY OF PNS SECRETIONS AND DISTRIBUTION OF SINO-NASAL POLYPOSIS

BILATERAL CONCHA BULLOSA

(BULBOUS VARIETY ON THE LEFT AND LAMELLAR VARIETY ON THE RIGHT SIDE)



DNS WITH NASAL SPUR TOWARDS LEFT SIDE



LEFT SIDED CONCHA BULLOSA WITH MILD DEVIATION OF NASAL SEPTUM TO RIGHT SIDE

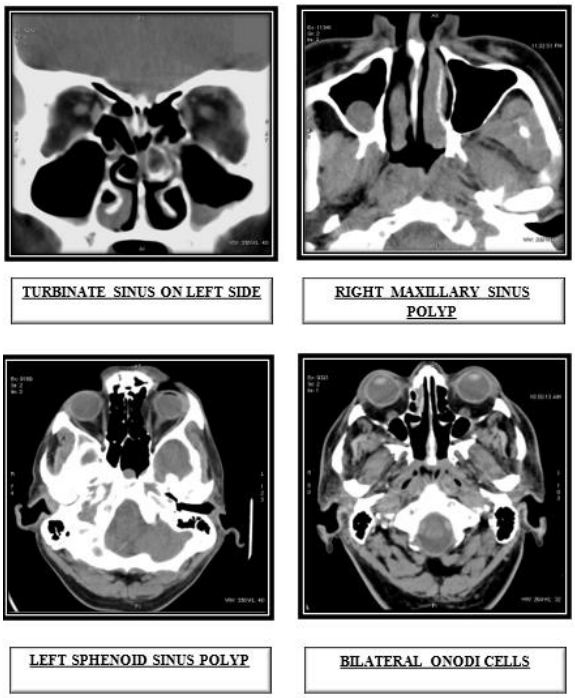
DNS WITH CONVEXITY TOWARDS LEFT SIDE

EXTENSIVE VARIETY OF CONCHA BULLOSA

VOMERAL PNEUMATISATION

BILATERAL AGGER NASI

RIGHT SIDED HALLER CELL



TURBINATE SINUS ON LEFT SIDE

RIGHT MAXILLARY SINUS POLYP

LEFT SPHENOID SINUS POLYP

BILATERAL ONODI CELLS

The results obtained in our study on paranasal sinus findings on CT in asymptomatic population were statistically similar to the results in comparable studies which had been conducted in other countries.

V. Conclusion

Computed tomography (CT) provides a "road map" for diagnosis and management of recurrent and chronic paranasal sinus disease and to delineate the bony anatomy before sinus surgery and to get an insight into anatomical variants apropos of their clinical relevance & impact on sinus disease, thereby aiding early diagnosis & prompt management with subsequent decrease in human morbidity and mortality.

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