ORIGINAL RESEARCH PAPER

Radiodiagnosis

SPECTRUM OF FINDINGS IN NCCT PNS IN PATIENTS WITH SINONASAL DISEASE.

KEY WORDS: NCCT PNS, paranasal sinus, sinonasal disease

Dr. Anindita Sarma 301, Skyline Amogha Apartments, Dayananda Sagar college road, Kumaraswamy Layout, Bengaluru, Karnataka, India

Dr. Shubhra Rathore* A11 Multiplex, Senior Doctors Campus Christian Medical College & Hospital, Ludhiana*Corresponding Author

Dr. Navneet Kumar Dept. Of ENT, Christian Medical College & Hospital, Ludhiana

ABSTRACT

Introduction: As physical examination can be nonspecific, radiological evaluation with non contrast CT (NCCT) aids in confirming diagnosis of paranasal sinus pathology and also allows delineation of disease and anatomic variations in this region. In this study we noted the spectrum of CT findings associated in patients with sinonasal disease.

Materials and Methods: NCCT scans of 200 patients presenting with sinonasal disease were studied. Note was made of the normal variants and any PNS pathology. Results were tabulated and analysed using EpiData Analysis software and statistical techniques.

Result: The most common variant was deviated nasal septum (76.5%) and agger nasi cells (65%). 39.5% of patients scanned had sinusitis (2% acute, 37.5% chronic). 14.5% patients had fungal sinusitis (6.5% allergic, 8% invasive). Polypoidal mucosal thickening was seen in 33 patients (16.5%). One case of mucocele was identified (0.5%). Neoplasm was identified in 6 patients (3%). Other non-sinonasal diseases were also identified such as pituitary macroadenoma (3%), oro-antral fistula (1%), impacted molars, dentigerous cyst, epidermoid cyst, osteomyelitis and orbital cellulitis (0.5%). No sinonasal abnormality could be detected in 39 patients (19.5%).

Conclusion: NCCT PNS aids not just to diagnose sinonasal disease but also provides excellent anatomical roadmap for surgery. In addition it may detect other unsuspected disease processes.

INTRODUCTION

Currently the gold standard for diagnosis of sinus diseases is Computed Tomography (CT). It provides excellent anatomical details of the sinuses and its pathology and hence is considered a road map before undergoing Functional Endoscopic Sinus Surgery (FESS).

Sinus disease manifests as mucosal thickening seen on imaging. However it can be present in both symptomatic and asymptomatic patients; hence differentiating between the two without adequate clinical history is difficult. Presence of air fluid levels favors acute sinusitis. The cause of sinonasal disease can often be discernable on imaging, such as obstructive anatomical variant [1] or mass, dental diseases such as periapical abscess or bony erosions leading to direct communication between maxillary sinus and oral cavity. Complications of sinonasal disease like bony wall thickening, erosions, mucoceles, etc are easily identified on CT, and orbital or intracranial extent on MRI. Mucosal thickening with high density secretions on CT with or without calcifications are seen in chronic inspissated secretions and non-invasive fungal disease.

In this study, we evaluated the CT findings in the paranasal sinus in 200 patients who underwent an NCCT PNS for sinonasal disease evaluation.

MATERIALS AND METHODS

This cross sectional study was conducted with consent on 200 patients who underwent NCCT of paranasal sinus for symptoms suggestive of sinonasal disease. Patients with prior sinonasal surgery, malignancy, facial trauma and children below 10 years were excluded from this study. Scans were done on Philips Ingenuity 128 slice CT scanner acquired in contiguous axial slices of 3 mm thickness with 1.5 mm interval reconstructed to 1mm with 0.5 mm interval taken to involve all paranasal sinuses and reconstructed in axial, coronal and sagittal planes.

Any normal variants or PNS pathology was noted. Results were duly tabulated and analysed using EpiData Analysis software and statistical techniques including Chi-square test.

Result and Analysis

Out of total 200 patients included in this study, 109 were male (54.5%). 61 were between 11 and 30 years of age (30.5%), 75 between 31 and 50 years (37.5%), 56 patients between 51 and 70 years (28%) and remaining 8 patients were between 71 and 90 years old (4%). Common anatomic variants noted are tabulated.

Table 1: Common anatomical variants of paranasal sinuses

Variants	Numberof patients	Percentage (%)
Deviated nasal septum	153	76.5 %
Concha bullosa	64	32 %
Agger nasi cells	130	65%
Haller cells	26	13%
Onodi cells	16	8%

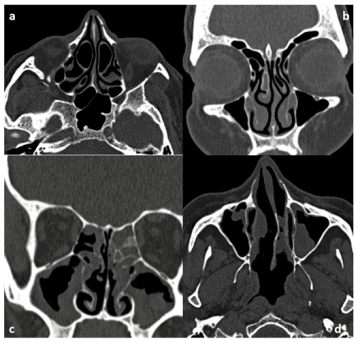

Figure 1 a.Bilateral concha bullosa .b. Bilateral lamellar concha. c. Paradoxical right middle turbinate. d. Deviated nasal septum.

Table 2: Middle Turbinate observations

Structure and variant observed	Right side		Left side	
	Number	Percentage	Number	Percentage
Normal in structure without mucosal	72	36.0 %	84	42.0 %

Normal in structure with mucosal thickening	32	16.0 %	36	18.0 %
Paradoxical	24	12.0 %	12	6.0 %
Concha bullosa	43	21.5 %	34	17.0 %
Lamellar concha	22	11.0 %	26	13.0 %
Not clearly visualized	7	3.5 %	8	4.0 %

The different diseases encountered in the study were diagnosed as above. Further classification of sinusitis into acute and chronic, and paranasal sinus disease of fungal etiology into 2 types: allergic fungal and invasive fungal sinusitis was done. Other disease processes encountered were also noted as above. No abnormality was detected in the NCCT PNS scans of 19.5% of the patients and hence no diagnosis could be made on the scans alone in these patients.

Table 3: Diagnosis of paranasal diseases & others

Diagnosis	Number	Percentage (%)
Sinusitis - Acute - Chronic	79 4 75	39.5% 2% 37.5%
Mucocele	1	0.5 %
Polypoidal mucosal thickening	33	16.5 %
Fungal - Allergic - Invasive	29 13 16	14.5 % 6.5 % 8
Others (including non-sinonasal) - Neoplastic - Pituitary macroadenoma - Oro-antral fistula - Impacted molars - Dentigerous cyst - Epidermoid cyst - Osteomyelitis - Orbital cellulitis	19 6 6 2 1 1 1 1 1	9.5 % 3 % 3 % 1 % 0.5 % 0.5 % 0.5 % 0.5 % 0.5 %
No abnormality detected	39	19.5 %

Table 4: Types of fungal sinusitis in different age groups

Age group	Allergic fungal	Invasive fungal	Total number
11-30 years	11	0	11
31-50 years	2	13	15
51-70 years	0	2	2
71-90 years	0	1	1
Total number	13	16	29

Chi-square = 22.0, p = 0.000; Degree of freedom = 3
The different types of fungal sinusitis encountered in different age groups was tabulated as above and showed a significant association.

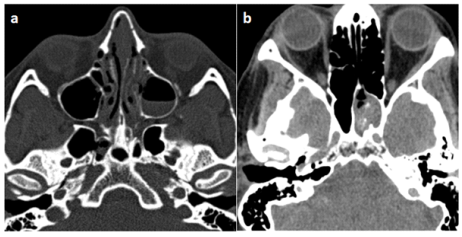

Figure 2. a. Air-fluid level in left maxillary sinus. b. Hyperdense sphenoid sinus contents from fungal sinusitis.

Incidence of various neoplastic lesions: The neoplastic lesions encountered in our study were 1 case of benign sinus papilloma and 3 cases of benign osteoma (seen in the left ethmoid sinus in 1 patient and in the left frontal sinus in 2 patients); one case of primary sinonasal carcinoma and one case of lymphoma.

Table 5: Types of fungal sinusitis in different age groups

Age group	Allergic fungal	Invasive fungal	Total number
11-30 years	11	0	11
31-50 years	2	13	15
51-70 years	0	2	2
71-90 years	0	1	1
Total number	13	16	29

Chi-square = 22.0, p = 0.000; Degree of freedom = 3
The different types of fungal sinusitis encountered in different age groups was tabulated as above

DISCUSSION

CT plays an important diagnostic role to determine the distribution and extent of paranasal disease and detect anatomic variations like nasal septal deviation, spurs, concha bullosa, aggernasi cells, paradoxical middle turbinate, uncinate bulla, medially or laterally bent uncinate process, oversized ethmoidal bulla etc.[4] These anatomic variants infringe on the patency of the already narrow ostiomeatal channels.[5] This blockade leads to impaired drainage of maxillary, frontal and anterior ethmoid thus causing chronic sinusitis.[6] No significant association could be found between anatomical variants and the different age groups.

Deviated nasal septum was the most common anatomical variation found in this study with an incidence of 76.5% as compared to the 88% found in study conducted by Tiwari and Goyal[5] and 62% by Lingaiah et al[7]. This study showed a much higher incidence of DNS as compared to Dua et al's[6] 44% and Onwuchekwa et al's[8] 20%.

The middle turbinate also showed significant variations including concha bullosa[9] interlamellar cell of Grunwald/ lamellar bulla/ conchal neck air cell or lamellar concha. A large concha bullosa can cause septal deviation and obstruct the ethmoid infundibulum.[10] If middle turbinate convexity is directed lateral (paradoxical), it can contribute to narrowing of the middle meatus.[7] Concha bullosa was seen in 32% of patients, at par with the 36% pneumatised middle turbinate found by Onwuchekwa et al.[8] but lesser than 76.4% found in Tiwari and Goyal's study[5], and higher than Dua et al.'s[6] 16%. Lamellar concha and paradoxical curvature of the middle turbinates was found to be atleast 12% each. Even Dua et al, Tiwari et al and Lingaiah et al have reported similar incidences of paradoxical middle turbinate at 10%, 10.5% and 14% respectively.

Agger nasi is the anterior most ethmoidal air cell, lying in close relation to the frontal recess. The degree of pneumatization of the agger nasi cell varies and affects the size of the frontal sinus ostium and shape of frontal recess. In 26 cases the region of anterior ethmoidal air cells were highly opacified and it was difficult to determine the presence or absence of agger nasi cells. Hence agger nasi cells were considered to be present in 130 (74.7%) of the remaining 174 patients scanned. This almost falls within the limits stated by Huang et al.[11], in their observations based on different studies with cell occurrence in 78%–98.5% of population. Our study found incidence of agger nasi cells to be slightly lesser than the 94% and 90% found in studies conducted by Sagar et al.[12] and Eweiss and Khalil[13], respectively; but higher than those found in Dua et al, Lingaiah et al and Onwuchekwa et al who observed 40%, 26% and 26% respectively.

Haller cells are pneumatized infraorbital ethmoid air cells along the medial wall of maxillary sinus and lie below the ethmoid bulla, lateral to the uncinate process, hence narrowing the infundibulum.[9] Haller cells were found in 14% of patients in this study which is comparable to that of Dua et al's 16% and Lingaiah et al's 11%.

The Onodi or the sphenoethmoidal air cell is the posterior

ethmoidal air cell which extends superiorly into sphenoid sinus. Onodi cells in this study had an occurrence of 8%, similar to that of Onwuchekwa et al, Lingaiah et al and Dua et al who reported 7.3%, and 6% each respectively.

The optic nerve is closely related to the posterior ethmoid cells and sphenoid sinus and has been characterized into one of four types by Delano et al. Extensive pneumatization predisposes to optic nerve injury.[14] Types 3 and 4 optic nerve canals are more susceptible to iatrogenic injury as they are usually dehiscent of surrounding bony wall. In this study, the prevalence of type I optic nerve was 59-64%, type II 20-24%, type III 9-12% and type IV 5-6%. This is in accordance to both the studies conducted by DeLano et al and Itagi et al with prevalence of type I optic nerve to be 76% and 60%, type II optic nerve 15% and15%, type III 6% and 14%, and type IV as 3% and 11%, respectively.

Dehiscence of optic nerve canal was present bilaterally in 8%, 3% on the right side alone, and 1.5% on left side alone. Hence dehiscence was seen in totally 12.5% cases. Dehiscence was absent in the remaining 87.5% of the patients. This was in concordance with that of Itagi et al who found a dehiscence rate of 17.5%, but it was almost half that of DeLano et al's 24%. A significant association was found between presence of Onodi cells and optic nerve canal dehiscence with p=0.000.

The different paranasal sinus diseases encountered in our study were sinusitis (39.5%), fungal infections (14.5%) of allergic (13%) and invasive (15%) types, polypoidal mucosal thickening (16.5%), mucocele (0.5%) and neoplasms (3%). Other diseases mimicking sinonasal disease were also found at a rate of 6.5%. Prevalence of allergic fungal sinusitis was estimated at 5%–10% of all patients by Aribandi et al.[15] Polypoidal mucosal thickening was more frequently seen in male patients as compared to females. However there was no significant association found between disease and sex of the patient. The incidence of sinonasal tumors both benign and malignant was found in only 3% of cases totally in our study (4 benign and 2 malignant). Eggesbo[16] has also stated that sinonasal tumours are rare, comprising of only 3% of all head and neck cancers and 1% of all malignancies.

In conclusion, the results obtained were found to be statistically comparable to prior studies. Due to the variable anatomy found in the paranasal sinus region, this is not an exhaustive study. It was difficult to diagnose some of the anatomical variations of different structures due to severe mucosal thickening exhibited in some patients. NCCT PNS plays a vital role not just to diagnose sinonasal disease but also to plan for surgery as it provides an anatomical roadmap and alerts about existing variant anatomy.

REFERENCES

1. Kazmi KS, Shames JP. Imaging of the paranasal sinuses. 2015. 4(3):1–14.
2. DeLano MC, Fun FY, Zinreich SJ. Relationship of the optic nerve to the posterior paranasal sinuses: a CT anatomic study. AJNR Am J Neuroradiol. 1996 Apr;17(4):669–75.
3. Itagi RM, Adiga CP, Kalenahalli K, Goolahally L, Gyanchandani M. Optic Nerve Canal Relation to Posterior Paranasal Sinuses in Indian Ethnics: Review and Objective Classification. J Clin Diagn Res JCDR. 2017 Apr;11(4):TC01-TC03.
4. Kanwar SS, Mital M, Gupta PK, Saran S, Nishtha P, Singh A. Evaluation of paranasal sinus diseases by computed tomography and its histopathological correlation. J Oral Maxillofac Radiol. 2017;5(2):46–52.
5. Tiwari R, Goyal R. Study of Anatomical Variations on CT in Chronic Sinusitis. Indian J Otolaryngol Head Neck Surg. 2015 Mar;67(1):18–20.
6. Dua K, Chopra H, Khurana AS, Munjal M. CT scan variations in chronic sinusitis. Indian J Radiol Imaging. 2005 Jul 1;15(3):315.
7. Lingaiah RKN, Puttaraj NC, Chikkaswamy HA, Nagarajaiah PKC, Purushothama S, Prakash V, et al. Anatomical variations of paranasal sinuses on coronal CT-scan in subjects with complaints pertaining to PNS. Int J Anat Radiol Surg. 2016:9:1–7.
8. Onwuchekwa RC, Alazigha N. Computed tomography anatomy of the paranasal sinuses and anatomical variants of clinical relevants in Nigerian adults. Egypt J Ear Nose Throat Allied Sci. 2017;18(1):31–8.
9. Reddy UDMA, Dev B. Pictorial essay: Anatomical variations of paranasal sinuses on multidetector computed tomography-How does it help FESS surgeons? Indian J Radiol Imaging. 2012;22(4):317–24.
10. Joshi VM. Paranasal Sinuses-Decongested! Neuroimaging Clin N Am. 2015 Nov;25(4):xiii.
11. Huang BY, Lloyd KM, DelGaudio JM, Jablonowski E, Hudgins PA. Failed endoscopic sinus surgery: Spectrum of CT findings in the frontal recess. Radiographics. 2009 Jan;29(1):177–95.
12. Sagar GRS, Jha BC, Meghanadh KR. A Study of Anatomy of Frontal Recess in Patients Suffering from 'Chronic Frontal Sinus Disease.' Indian J Otolaryngol Head Neck Surg. 2013 Aug;65(Suppl 2):435–9.
13. Eweiss AZ, Khalil HS. The Prevalence of Frontal Cells and Their Relation to Frontal Sinusitis: A Radiological Study of the Frontal Recess Area [Internet]. International Scholarly Research Notices. 2013 [cited 2017 Dec 22]. Available from: https://www.hindawi.com/journals/isrn/2013/687582/
14. Heskova G, Mellova Y, Holomanova A, Vybohova D, Kunertova L, Marcekova M, et al. Assessment of the relation of the optic nerve to the posterior ethmoid and sphenoid sinuses by computed tomography. Biomed Pap Med Fac Univ Palacky Olomouc Czechoslov. 2009 Jun;153(2):149–52.
15. Aribandi M, McCoy VA, Bazan C. Imaging features of invasive and noninvasive fungal sinusitis: a review. Radiogr Rev Publ Radiol Soc N Am Inc. 2007 Oct;27(5):1283–96.
16. Eggesbř HB. Imaging of sinonasal tumours. Cancer Imaging Off Publ Int Cancer Imaging Soc. 2012 May 7;12:136–52.