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Incidence of sinonasal anatomical variations associated with chronic sinusitis by CT scan in Karaikal, South India

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ABSTRACT

Background: Variations in sinonasal anatomy of adults are common and vary among different populations. Their role in development of pathological conditions such as sinusitis, epistaxis, etc is debated. Having clear picture of sinonasal anatomy of a person is essential in avoidance of complications during surgery. This study was done to analyze sinonasal anatomy in adults from Karaikal region having chronic sinusitis by nasal endoscopy and CT scan imaging.
Methods: A total of 50 patients undergoing endoscopic sinus surgery were studied by preoperative nasal endoscopy, CT scanning and endoscopy at the time of definitive surgery and variations recorded and analyzed.
Results: The incidence of the sinonasal anatomical variations in CT scan study were – discharge in the frontal sinus (100%), agger nasi cells (96%), deviated nasal septum (70%), anterior ethmoidal cells (86%), posterior ethmoidal cells (58%), sinus lateralis (52%), frontal cells (50%), discharge in sphenoid sinus (50%), pneumatised superior turbinate (46%), INSA (34%), prominent bulla ethmoidalis (30%), supra orbital cells (26%), pneumatised septum(16%), medialised uncinate process (16%), paradoxical middle turbinate (16%), Haller cells (14%), supreme turbinate (14%), pneumatised inferior turbinate (12%), frontal recess obliteration (12%), absent pneumatisation of frontal sinus (12%), pneumatised middle turbinate (10%), Onodi cells (6%), pneumatised uncinate process (2%), maxillary sinus septation (2%).
Conclusions: The high incidence of variations emphasises the need for proper preoperative assessment for safe and effective endoscopic sinus surgery.

Keywords: Paranasal sinuses, Anatomical variations, Chronic sinusitis, Diagnostic nasal endoscopy, CT paranasal

INTRODUCTION

Sinonasal diseases, especially rhino-sinusistis, are commonly encountered health problems in otorhinolaryngology practice. Variations in sinonasal anatomy such as deviated nasal septum, agger nasi, Haller cells, etc are common in the population.[1] The prevalence of these variations differs in various ethnic populations.[2] Role of sinonasal anatomical variations in the causation of chronic rhinosinusitis is still debated though it cannot be ruled out altogether.[1,3] Although sinusitis is a clinically diagnosed condition, imaging studies are used to assess the disease and demonstrate the sinonasal anatomy.[4] CT scan and nasal endoscopy are preferred diagnostic modalities to determine the mucosal abnormalities and bony anatomic variations of paranasal sinus and assess the possible pathogenicity of these findings in patients undergoing evaluation for sinusitis.[5] Chronic sinusitis patients not responding to antibiotic

therapy need surgical clearance of infected sinuses and establishment of ventilation and drainage.[5] It is widely accepted that a good knowledge of anatomical variations helps in preventing complications while performing sinus surgeries.[1,6] This study was undertaken to determine and compare the common sinonasal anatomical variations by CT scan in chronic sinusitis patients in Karaikal, South India.

METHODS

Fifty patients attending the outpatient department of otorhinolaryngology, Vinayaka Mission's Medical College and Hospital, Karaikal between July 2012 to December 2012, with clinical evidence of chronic sinusitis were included in this study. Inclusion criteria were adults with sinusitis for more than 12 weeks which persisted despite medical therapy and required surgical management. Patients who were previously operated and patients with facial anomalies were excluded. Selected patients after clinical examination and diagnostic nasal endoscopy were subjected to CT scan paranasal sinuses evaluation prior to functional endoscopic sinus surgery (FESS).

Diagnostic nasal endoscopic examination was done with 4 mm serwell rod endoscopes with 0° and 30° angulations. First, second, and third pass evaluation of nasal cavity were done after proper decongestion and topical anesthesia of the nasal cavity of the patients.

In patients with acute symptoms, a course of antibiotics, nasal decongesants and antihistaminics were given for a period of 2 weeks before CT scan. Nasal decongestant (xylometazoline) was administered 15 minutes prior and patients were asked to blow the nose forcefully just prior to the CT scan. CT scan was performed in a Toshiba CT scanner. Direct coronal sections were done in all the patients. Limited axial scans parallel to the orbitomeatal line, with the patients in supine position, were also done whenever required. All the CT scan studies were done without contrast. All the data collected were tabulated in Microsoft Excel and percentages were calculated to determine the incidences.

RESULTS

Study subjects included 25 men and women each, 78% belonging to 20-50 age group (Figure 1).

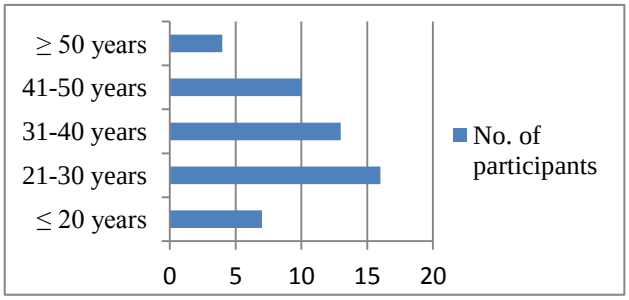

Figure 1: Age distribution of the study participants.

Table 1: Findings of CT scan of paranasal sinuses.

Anatomical variations	Right side only (%)	Left side only (%)	Bilateral (%)	Total (%)
Deviated nasal septum	19 (38)	16 (32)	-	35 (70)
Pneumatised septum	-	-	8 (16)	8 (16)
Pneumatised middle turbinate	1 (2)	2 (4)	3 (6)	6 (12)
Pneumatised inferior turbinate	1 (2)	1 (2)	4 (8)	6 (12)
Pneumatised uncinate process	0 (0)	0 (0)	1 (2)	1 (2)
Medialised uncinate process	1 (2)	1 (2)	6 (12)	8 (16)
Agger nasi cells	0 (0)	0 (0)	48 (96)	48 (96)
Haller cells	1 (2)	2 (4)	4 (8)	7 (14)
Onodi cells	0 (0)	1 (2)	2 (4)	3 (6)
Prominent bulla ethmoidalis	2 (4)	1 (2)	12 (24)	15 (30)
Frontal cells	8 (16)	5 (10)	12 (24)	25 (50)
Anterior ethmoidal cells	11 (22)	9 (18)	23 (46)	43 (86)
Posterior ethmoidal cells	5 (10)	6 (12)	18 (36)	29 (58)
Discharge – frontal sinus	12 (24)	10 (20)	28 (46)	50 (100)
Discharge – maxillary sinus	6 (12)	7 (14)	20 (40)	33 (66)
Discharge – ethmoidal sinus	11 (22)	10 (20)	24 (48)	45 (90)
Discharge – sphenoid sinus	3 (6)	5 (10)	17 (34)	25 (50)
Maxillary sinus septation	0 (0)	1 (2)	0 (0)	1 (2)
Supreme turbinate	0 (0)	0 (0)	7 (14)	7 (14)
Sinus lateralis	8 (16)	9 (18)	9 (18)	26 (52)
Supraorbital cells	1 (2)	4 (8)	8 (16)	13 (26)
INSA	0 (0)	0 (0)	17 (34)	17 (34)
Frontal sinus obliteration	2 (4)	3 (6)	1 (2)	6 (12)
Absent pneumatisation frontal sinus	4 (8)	1 (2)	1 (2)	6 (12)
Paradoxical middle turbinate	4 (8)	1 (2)	3 (6)	8 (16)

Cough and headache were the commonest symptoms. Half of the patients had nasal polyps, 46% had ethmoidal polyps and 4% had antrocoanal polyps. Nasal discharge was seen in all the patients on clinical examination and 80% patients had post nasal discharge. In DNE 46% patients had discharge in middle meatus, 36% patient had discharge in spenoethmoidal recess and 16 patients had discharge in superior meatus. Deviation of nasal septum on clinical examination, diagnostic nasal endoscopy as well as CT of para nasal sinuses was present in 70% patients and pneumatisation of septum in 16% patients and INSA was present in 34% patients which could be seen only in CT of PNS. Mucosal congestion was present in 64% patient on clinical examination and DNE. Frontal sinus tenderness was present in 64% patients, ethmoidal sinus tenderness and maxillary sinus tenderness was present in all the patients. Findings by preoperative CT scan PNS are listed in the above Table 1.

Figure 2: Agger nasi cells (arrows).

Figure 3: Concha bullosa (arrow) and hypertrophied inferior turbinate -left side.

DISCUSSION

Management of chronic sinusitis which does not respond to medical line of therapy has evolved over time from more invasive surgical procedures to less invasive endoscopic procedures (FESS) which generally aims at removing the infective nidus from the sinuses and improving the sinus drainage and ventilation.[7] FESS requires a thorough knowledge of anatomy of the paranasal sinuses of the individual who is undergoing the procedure in order to prevent injury to the vital structures present around the osteomeatal complex. Since anatomical variations are common in any population and this variation is often ethnic based on genetic and environmental factors.[8,9] An anatomic variation study reviewing the CT scans of 100 Caucasian and 100 Chinese patients found statistically significant difference in the occurrence of concha bullosa, pneumatised middle turbinate, Haller and Onodi cells between the two groups.[10] Literature review showed no such published data in this geographical region. The study such as ours helps in understanding what is common in a given population and be prepared and tailor the surgical approach accordingly.

Although chronic sinusitis is a clinically diagnosable condition, imaging studies are essential for assessing the extent of the disease and planning for surgical treatment.[1] At present CT scan study especially using coronal plane due to its similarity with the surgical orientation, is the most preferred imaging investigation for this purpose.[3,11,12] CT provides a good perspective of sinonasal anatomy and pathology of both the bone and the soft tissue components, and thus is considered superior to plane radiography and nasal endoscopy.[8] Hence, in this study CT coronal sections were chosen to study the anatomical variations.

Although the presence of sinonasal anatomical variations as a cause of sinusitis is debated, it is widely accepted that obstruction at the osteomeatal complex leads to a vicious cycle of mucosal congestion which decreases air flow and leading to further obstruction.[13] Surgical clearance of these chronically infected sinuses while maintaining their ventilation and drainage is the treatment of choice.[14] It has been reported that 35-40% patients with clinically significant sinusitis may have no or minimal evidence of sinusitis in CT imaging assessment.[15,16] From these observations it may be derived that if sinonasal anatomical variations are able to block osteomeatal complex then they can predispose to sinusitis. It is also possible that patients with CT scans showing no or minimal evidence of sinus inflammation may have had significant sinusitis on previous CT scans that improved or resolved even though they continued to experience sinusitis symptoms.[6] To minimize such problems in the present study, the chronic sinusitis patients were given a course of antibiotics antihistaminics and nasal decongestants just before the CT scan study.

In this study the commonest anatomical variation found was agger nasi (98%). Agger nasi cells, which are most anterior ethmoid cells, are located anteriorly to the plane of the maxillary sinus infundibulum. Other studies have found wide variation (2-83%) in occurrence of agger nasi.[4-6,8] Studies demonstrate that their major dimensions are correlated with frontal sinus diseases and lacrimation.[7] All the subjects in the study had discharge in the frontal sinus.

Septal deviation was the second most common anatomical variation in the study (70%). Septal deviation has been observed to be 14-80% in other studies.

Several other similar studies have found DNS as the commonest anatomical variation.[5,6,8,10] Shift of the nasal septum away from the midline is usually associated with deformity or asymmetry of the adjacent turbinates or of the nasal wall structures, with variable presentation. Deviation of nasal septum can decrease the critical area of the osteomeatal unit predisposing to obstruction and related complications.[5] Deviation of the nasal septum is measured by drawing a line from Crista galli to maxillary crest and another line to the maximum deviation of nasal septum. The angle formed is calculated.[7] Other commonly observed sinonasal anatomical variations along with the findings of this study are tabulated in Table 2 for comparison.

Table 2: Comparison of incidence of common sinonasal anatomical variations in different studies.

Author and country	Sample size	DNS	Agger nasi	Haller cells	Onodi cells	Concha bullosa	Horizontal uncinate	Enlarged bulla ethmoidalis
Present study	50	65	48	7	3	24	8	15
Adeel M et al[10], Pakistan	77	26	-	9	8	18	4	-
Kaygusuz A et al[4], Turkey	99	72	61	16	8	45	16	31
Pradeep Kumar et al[8], India	100	62	56	21	15	43	82	57
Shpilberg KA et al[6], USA	192	98	83	39	12	48	13	45
Aramani A et al[5] India	54	74	2	2	-	53	9	-
Thimmappa TD et al[7], India	100	47	68	13	-	37	1	-

There is a strong consensus that knowledge of sinonasal anatomy and its variations is essential for safe and effective FESS or other skull base surgeries.[1,6] The presence of sphenoethmoidal (Onodi) cells is associated with increased risk of injuring the optic nerves or carotid arteries during FESS and with other transsphenoidal and skull base procedures.[17,18,19] To avoid accidental injury to the carotid artery and optic nerves, it is important to be aware of the midline of a highly pneumatized sphenoid sinus when opening the sella via a transsphenoidal approach.[20] Postsellar pneumatization from the sphenoid sinus, particularly pneumatisation of the dorsum sella, may result in penetration of the posterior wall of the sphenoid with resultant CSF leak during transsphenoidal pituitary surgery.[20]

The presence of infraorbital ethmoidal (Haller) cells can increase the risk of orbital injury during ethmoidectomy. The presence of supraorbital cells can increase the risk of orbital damage during FESS and may also affect the sterility in anterior cranial fossa approaches to the orbit.[18] Failure to recognize a supraorbital cell with the anterior ethmoidal artery as a landmark during surgery increases the risk of skull base injury because CSF leaks and retraction of a lacerated anterior ethmoidal artery into the orbit can occur.[21] Dehiscence of the lamina papyracea can lead to prolapse of orbital contents into the ethmoidal sinuses and puts the patient at risk of hemorrhage or damage to the orbit during endoscopic intranasal ethmoidectomy.[22]

Radiologists should assume that all patients undergoing CT for chronic rhinosinusitis will be undergoing surgery and include the presence of anatomic variants in the reports. Although surgical complications occur for a variety of reasons, failure to recognize certain anatomic variants is an important factor, and radiologists have a responsibility to comment on the presence of certain anatomic variants and ENT surgeons to look for them to minimize the likelihood of surgical complications.[6]

We can conclude that, among the people suffering from chronic sinusitis in this region anatomical variations in sinonasal ara are common with DNS, agger nasi and sinus cells being the commonest. The high incidence of variations emphasises the need for proper preoperative assessment for safe and effective endoscopic sinus surgery.

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REFERENCES

1. Gebrim ES. Relevance of sinonasal anatomical variations in the preoperative evaluation by computed tomography for endonasal surger. Radiol Bras. 2008;41:5-6
2. Badia L, Lund VJ, Wei W, Ho WK. Ethnic variation in sinonasal anatomy on CT-scanning. Rhinology. 2005;43:210-4.
3. Jones NS. CT of the paranasal sinuses: a review of the correlation with clinical, surgical and histopathological findings. Clin Otolaryngol Allied Sci. 2002;27:11-7.
4. Kaygusuz A, Haksever M, Akduman D, Aslan S, Sayar Z. Sinonasal Anatomical Variations: Their Relationship with Chronic Rhinosinusitis and Effect on the Severity of Disease—A Computerized Tomography Assisted Anatomical and Clinical Study. Indian J Otolaryngol Head Neck Surg. 2014;6:260–6.
5. Aramani A, Karadi RN, Kumar S. A Study of Anatomical Variations of Osteomeatal Complex in Chronic Rhinosinusitis Patients-CT Findings. J Clin Diag Res. 2014;8:1-4.
6. Shpilberg KA, Daniel SC, Doshi AH, Lawson W, Som PM. CT of Anatomic Variants of the Paranasal Sinuses and Nasal Cavity - poor Correlation With Radiologically Significant Rhinosinusitis but Importance in Surgical Planning. Neuroradiology/Head and Neck Imaging AJR. 2015;204:1255-60.
7. Thimmappa TD, Amith P, Nagaraj M, Harsha KN, Gangadhar KS, Azeem A. Anatomical variations of sinonasal region: a CT scan study. Int J Res Med Sci. 2014;2:1441-5.
8. Kumar P, Rakesh BS, Prasad R. Anatomical variations of sinonasal region, a coronal ct scan study. Int J Contemporary Med Res. 2016;3(9):2601-4.
9. Lebowitz RA, Terk A, Jacobs JB, Holliday RA. Asymmetry of the ethmoid roof: analysis using coronal computed tomography. Laryngoscope. 2001;111:2122–4.
10. Adeel M, Rajput MS, Akhter S, Ikram M, Arain A, Khattak YJ. Anatomical variations of nose and para-nasal sinuses; CT scan review. J Pak Med Assoc. 2013;63(3):317-9.
11. Stankiewicz JA, Chow JM. The low skull base-is it important? Curr Opin Otolaryngol Head Neck Surg. 2005;13:19–21.
12. Hudgins P. Complications of endoscopic sinus surgery: the role of the radiologist in prevention. Radiologic Clin North Am. 1993;31:21–32.
13. Becker Samuel S, Becker Daniel G. Diagnosis and Management of Disorders of the Nose and Sinuses. Available from: URL: http: // www. sinustreatmentcenter.com /BOOK/ chapter11_0109.pdf. Accessed on 15 July 2011.
14. Dua K, Chopra H, Khurana AS, Munjal M. CT scan variations in chronic sinusitis. Ind J Radiol Imag. 2005;15:315-20.
15. Hwang PH, Irwin SB, Griest SE, Caro JE, Nesbit GM. Radiologic correlates of symptom-based diagnostic criteria for chronic rhinosinusitis. Otolaryngol HeadNeck Surg. 2003;128:489–96.
16. Ferguson BJ, Narita M, Yu VL, Wagener MM, Gwaltney JM Jr. Prospective observational study of chronic rhinosinusitis: environmentaltriggers and antibiotic implications. Clin Infect Dis. 2012;54:62–8.
17. Kantarci M, Karasen RM, Alper F, Onbas O, Okur A, Karaman A. Remarkable anatomic variations in paranasal sinus region and their clinical importance. Eur J Radiol. 2004;50:296–302.
18. Nouraei SA, Elisay AR, Dimarco A, Abdi R, Majidi H, Madani SA, et al. Variations in paranasal sinus anatomy: implications for the pathophysiology of chronic rhinosinusitis and safety of endoscopic sinus surgery. J Otolaryngol Head Neck Surg. 2009;38:32–7.
19. Tomovic S, Esmaeili A, Chan NJ, Shukla PA, Choudhry OJ, Liu JK, et al. High-resolution computed tomography analysis of the prevalence of Onodi cells. Laryngoscope 2012;122:1470–3.
20. Hamid O, El Fiky L, Hassan O, Kotb A, El Fiky S. Anatomic variations of the sphenoid sinus and their impact on trans-sphenoid pituitary surgery. Skull Base. 2008;18:9–15.
21. Comer BT, Kincaid NW, Smith NJ, Wallace JH, Kountakis SE. Frontal sinus septations predict the presence of supraorbital ethmoid cells. Laryngoscope. 2013;123:2090–3.
22. Han MH, Chang KH, Min YG, Choi WS, Yeon KM, Han MC. Nontraumatic prolapse of the orbital contents into the ethmoid sinus: evaluation with screening sinus CT. Am J Otolaryngol. 1996;17:184–9.

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