International Journal of Otorhinolaryngology and Head and Neck Surgery
Rajeev K et al. Int J Otorhinolaryngol Head Neck Surg. 2018 Jul;4(4):1008-1012
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937

Original Research Article

DOI: http://dx.doi.org/10.18203/issn.2454-5929.ijohns20182703

Anatomical variations of maxillary and ethmoid sinus in chronic rhinosinusitis

Karthika Rajeev, Ravishankara S.*, Chethana C. S., Supreetha B. Shenoy, Jyoti

Department of Otorhinolaryngology Head and Neck Surgery, KVG Medical College, Sullia, Karnataka, India

Received: 24 March 2018
Accepted: 04 May 2018

***Correspondence:**
Dr. Ravishankara S.,
E-mail: drraveesha@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: The objectives of the study were to compare the anatomical variants of maxillary and ethmoid sinus in CT PNS and diagnostic nasal endoscopy, to determine the incidence of variations of maxillary and ethmoid sinus and to determine the association of anatomical variations with extent of the disease.
Methods: Patients with chronic rhinosinusitis attending the outpatient department of otorhinolaryngology, head and neck surgery (ENT-HNS) of KVG Medical College for a period of 12 months from December 2016 to November 2017. 100 consecutive patients with history of CRS subjected for nasal endoscopy and CT-PNS.
Results: The majority of patients were females. Male to female ratio was 1:1.46. Headache and postnasal drip were the main symptoms (76%). Concha bullosa (42.4%) was most common anatomical variation, which was detected in 59(42.4%) patients on CT PNS and DNE. There was statistically significant correlation between right septal deviation and right maxillary sinusitis ($p<0.01$), left septal deviation and left maxillary sinusitis ($p=0.001$) and left deviation and left ethmoid sinusitis ($p=0.017$). We also found correlation between left Haller cells and left ethmoid sinusitis ($p=0.003$).
Conclusions: By using diagnostic nasal endoscopy and CT PNS, anatomic variations can be easily identified and aid as a guide map during functional endoscopic sinus surgeries.

Keywords: Anatomical variations, Computed tomography, Diagnostic nasal endoscopy

INTRODUCTION

Chronic rhinosinusitis, with its classical symptoms of nasal obstruction, nasal discharge (anterior and/or posterior), headache and facial pain, and abnormalities of smell is the most common disease for which consultation of otorhinolaryngologist is needed. Disruption of the mucociliary clearance due to anatomic variations and mucosal disease is the major pathogenesis for the continuation of symptoms and chronicity of disease.[1] Functional endoscopic sinus surgery (FESS) addresses these anatomical variations and mucosal diseases and restores the normal physiology of the paranasal sinuses.[2] Preoperative evaluation of these variants is also important being a part of surgical safety.[3] Diagnostic nasal endoscopy and computed tomography play a vital role in accurate assessment of anatomical variations. CT scan has the ability to delineate mucosal disease of sinuses, to detect primary obstructive pathology and to image the distal structures like posterior ethmoid.[4] Anatomic variations such as concha bullosa, Haller cells, agger nasi cells, pneumatization or paradoxical curvature of the middle turbinate, uncinate process, ethmoid bulla and maxillary sinus hypoplasia can now be imaged with a level of clarity along with the mucosal or polypoidal changes in the paranasal sinus. The present study was undertaken to study the various anatomical variations of maxillary and ethmoid sinuses in patients with chronic rhinosinusitis.[5]

Objective of the study

- To compare the anatomical variations of maxillary and ethmoid sinus in CT PNS and diagnostic nasal endoscopy.
- To determine the incidence of variations of maxillary and ethmoid sinus.
- To determine the association of anatomical variations with extent of the disease.

METHODS

Source of data

Patients with chronic rhinosinusitis attending the outpatient department of otorhinolaryngology, head and neck surgery (ENT-HNS) of KVG Medical College for a period of 12 months from December 2016 to November 2017.

Method of collection of data

100 consecutive patients with history of CRS subjected for nasal endoscopy and CT-PNS. CT paranasal sinuses was performed with 16 slice CT machine Seimens Somatom by direct axial and coronal sections. The images were reformated for sagittal section to evaluate entire anatomy. Endoscopes used were with 0 degree and 45 degree angles of view of 4mm diameters. Karl Storz Endovision Telecam deluxe camera sytem with monitor. Topical decongestant and anesthetic agent (4% Xylocaine with 1:100.000 adrenaline).findings were recorded. Data was entered in proforma after taking informed written consent.

***Sample size*:** 100

***Sampling*:** Cross sectional study**.**

Inclusion criteria

Inclusion criteria were all the patients with clinically proven chronic sinusitis; patients above fifteen years age.

Exclusion criteria

Exclusion criteria were patients with history of previous nasal surgery or trauma; pregnant patients; patient with sinus malignancies.

RESULTS

A total of 100 patients were included in the study. The age of patients ranged between 18-55 years. Mean age of the study is 38.04 (SD=11.17). The majority of patients were females. Male to female ratio was 1:1.46 (Table 1). Headache and postnasal drip were the main symptoms (76%) followed by facial pain (65%). Other symptoms were nasal blocks (29%), nasal discharge (24%), olfactory disturbance (8%). Most of the patients presented in this study with multiple symptoms (Table 2).

Table 1: Age and sex distribution of patients.

S.no.	Age distribution	Male (%)	Female (%)
1	18–25 years	9 (9)	7 (7)
2	26–35 years	12 (12)	19 (19)
3	36–45 years	8 (8)	13 (13)
4	46–55 years	11 (12)	21 (21)

Table 2: Symptom profile of patients.

S.no.	Symptoms	Total patients (%)
1	Nasal discharge	24 (24)
2	Nasal block	29 (29)
3	Headache	76 (76)
4	Facial pain	65 (65)
5	Olfactory disturbance	8 (8)
6	Post nasal drip	76 (76)
7	Others	2 (2)

As shown in Table 3, regarding the incidence of anatomical variations in maxillary sinus observations were, deviated nasal septum (35.2%), concha bullosa (42.4%), paradoxical middle turbinate (11.5%), pneumatised uncinate (5.75%), hypoplasia of maxillary sinus (1.43%).

Table 3: Incidence of anatomical variations in maxillary sinus.

S.no.	Variations	Unilateral (%)	Bilateral (%)	Total (%)
1	Concha bullosa	36 (25.89)	23 (16.54)	59 (42.44)
2	Deviated nasal septum	34 (24.46)	15 (10.79)	49 (35.25)
3	Paradoxical middle turbinate	10 (7.19)	6 (4.31)	16 (11.51)
4	Absent uncinate	0 (0)	0 (0)	0 (0)
5	Pneumatised uncinate	6 (4.31)	2 (1.43)	8 (5.75)
6	Hypoplasia of maxillary sinus	1 (0.71)	1 (0.71)	2 (1.43)
7	Dehiscent intraorbital canal	0 (0)	0(0)	0 (0)

Table 4: Incidence of anatomical variations in ethmoidal sinus (n=100).

S.no.	Variations	Unilateral (%)	Bilateral (%)	Total (%)
1	Olfactory fossa			
	- Keros 1	0	98	98
	- Keros 2	0	2	2
	- Keros 3	0	0	0
2	Agger nasi	21	14	35
3	Onodi cells	6	2	8
4	Haller cells	16	8	24

Table 5: Signs in diagnostic nasal endoscopy (n=100).

S.no.	Findings in	Right side (%)	Left side (%)
1	Deviated nasal septum	34	15
2	Mucopurulent discharge	57	53
3	Inferior turbinate hypertrophy	16	15
4	Paradoxical turbinate	8	8
5	Concha bullosa	29	30
6	Accesory ostium	13	13
7	Polyp	3	3

Table 6: Association of anatomical variations with chronic rhinosinusitis in CT scan.

S no	Anatomical variants	Sinusitis	Chi square value	P value
1	Deviated nasal septum -right	Maxillary sinusitis – right	18.5	<0.001*
2	Deviated nasal septum -left	Maxillary sinusitis – left	10.2	0.001*
3	Deviated nasal septum - right	Ethmoidal sinusitis – right	1.36	0.244
4	Deviated nasal septum – left	Ethmoidal sinusitis – left	5.65	0.017*
5	Concha bullosa – right	Maxillary sinusitis – right	0.732	0.392
6	Concha bullosa – left	Maxillary sinusitis – left	0.857	0.926
7	Concha bullosa – right	Ethmoidal sinusitis – right	2.23	0.135
8	Concha bullosa – left	Ethmoidal sinusitis – left	0.309	0.578
9	Bulla ethmoidalis – right	Maxillary sinusitis – right	1.16	0.281
10	Bulla ethmoidalis – left	Maxillary sinusitis – left	Na	Na
11	Paradoxical middle turbinate – right	Maxillary sinusitis – right	2.35	0.125
12	Paradoxical middle turbinate – left	Maxillary sinusitis – left	3.63	0.057
13	Paradoxical middle turbinate – right	Ethmoidal sinusitis - right	0.382	0.536
14	Paradoxical middle turbinate – left	Ethmoidal sinusitiis – left	0.233	0.630
15	Pneumatised uncinate – right	Maxillary sinusitis – right	0.201	0.887
16	Pneumatised uncinate – left	Maxillary sinusitis – left	0.960	0.327
17	Hypoplasia of maxillary sinus – right	Maxillary sinusitis – right	1.16	0.281
18	Hypoplasia of maxillary sinus – left	Maxillary sinusitis – left	1.05	0.305
19	Haller cells – right	Ethmoidal sinusitis – right	2.99	0.084
20	Haller cells – left	Ethmoidal sinusitis – left	8.58	0.003*
21	Haller cells – right	Maxillary sinusitis – right	1.04	0.308
22	Haller cells – left	Maxillary sinusitis – left	3.14	0.076
23	Agger nasi – right	Maxillary sinusitis – right	0.112	0.738
24	Agger nasi – left	Maxillary sinusitis – left	1.15	0.283
25	Agger nasi – right	Ethmoidal sinusitis – right	0.274	0.601
26	Agger nasi – left	Ethmoidal sinusitis – left	0.354	0.552

As shown in Table 4, regarding the incidence of anatomical variations in ethmoidal sinus, agger nasi (35%), haller cell (24%), keros 1 (98%), keros 2 (2%), onodi cell (8%), Pnumatized uncinate process (5.7%), hypoplasia of maxillary sinus (1.43%), depth of olfactory fossa, haller cells, onodi cells were detected only by CTPNS.

In the present study, the most frequent abnormality detected were mucopurulent discharge on right 57% and left 53% in diagnostic nasal endoscopy. Other abnormalities detected were concha bullosa (right-29%, left-30%), deviated nasal septum (right-34%, left-15%), inferior turbinate hypertrophy (right-16%, left-15%), accessory ostium (right-13%, left-13%), paradoxical turbinate (right-8%, left-8%) and polyp (right-3%, left-3%) (Table 5).

Various anatomical variants of nose and PNS in chronic rhinosinusitis patients were diagnosed on diagnostic nasal endoscopy and CTPNS. They were either unilateral or bilateral. We assessed the association of anatomical variations with chronic rhinosinusitis in CTPNS (Table 6). Concha bullosa (42.4%) was most common anatomical variation, which was detected in 59 (42.4%) patients on CT PNS and DNE.

Level of agreement between DNE and CT scan in diagnosing all these anatomical variations in Chronic Rhinosinusitis was analysed by chisquare test. We have found the difference to be non-significant between DNE & CT; and hence both are equally good (Table 6).

Haller cells and Onodi cells were detected only by CT scan in 6 (6%) and 8 (8%) patients respectively (Table 4).

Association of anatomical variations with chronic rhinosinusitis has been observed using chisquare test 9 (Table 5). There was statistically significant association between right septal deviation and right maxillary sinusitis ($p<0.01$), left septal deviation and left maxillary sinusitis ($p=0.001$) and left deviation and left ethmoid sinusitis ($p=0.017$). We also found correlation between left Haller cells and left ethmoid sinusitis ($p=0.003$). There was no other statistically significant association between any other anatomic variations and ipsilateral or contralateral sinusitis of any paranasal sinus.

DISCUSSION

Nasal endoscopy combined with CTPNS has made the approach to sinonasal disease more specific and accurate.[6] CTPNS shows fine bony anatomy of nasal paranasal sinuses.[3]

In our study age of patients varies between 18 and 55 years with the maximum number of patients in 46-55year category. The study conducted by Kirtane et al ranged from 16 to 52 years, with majority of patients cases (46.78%) were in the third decade.[7] In our study the majority of the patients 33 (33%) were in the third decade.

In the present study 100 patients, male to female ratio is 1:1.4. In the study conducted by Deosthale et al, male to female ratio were 1.9:1.[1]

In our study headache and postnasal drip were the main symptoms (76%). This findings corresponds with the study conducted by Gandotra et al, nasal discharge and headaches were the most common symptoms, and the next common symptoms were postnasal drip and nasal obstruction.[8]

Bolger et al, examined a detailed analysis of coronal plane CT scan paranasal sinuses obtained from 202 consecutively imaged patients. Special attention towards identifying bony anatomic variations of paranasal sinuses and mucosal abnormalities. Anatomic variations included pneumatisation of middle concha, paradoxical curvature of middle turbinate, Haller's cells, pneumatisation of uncinate process. Such bony anatomic variations were detected in 64.9% of 202 patients and were found with similar frequency in patients scanned for sinus complaints and in those scanned for non-sinus reasons. Mucosal abnormalities were detected in 83.2%. In the present study anatomical variations detected include concha bullosa (42.4%), deviated nasal septum (35.5%), haller cells (4.3%), paradoxical middle turbinate (11.5%), onodi cells (8%), hypoplasia of maxillary sinus (1.43%). For those patients scanned during the evaluation of sinus-like complaints, mucosal abnormalities were noted in 92.2% and was detected in anterior ethmoid region.[3]

In the present study, the most frequent abnormality detected were mucopurulent discharge on right 57% and left 53% in diagnostic nasal endoscopy. Other abnormalities detected were concho bullosa (right-29%, left-30%), deviated nasal septum (right-34%, left-15%), inferior turbinate hypertrophy (right-16%, left-15%), accessory ostium (right-13%, left-13%), paradoxical turbinate (right-8%, left-8%) and polyp (right-3%, left-3%). In the study conducted by Berrettini et al on nasal endoscopy of 40 chronic rhinosinusitis patients, abnormalities detected were hypertrophy of inferior turbinates (33 cases, 13 were obstructive, 5 bilateral), nasal septal deviation (26 cases, in 7 obstructive), secretions were present in 13 patients (as catarrhal discharge in 11 and purulent discharge in 2). In 8 cases, there was narrowing of osteomeatal complex. 4 patients had nasal polyps, while none had paradoxical middle turbinates. No significant correlation was found between the left and right CT scan and the homolateral endoscopy results ($p=1.00$).[9]

A study was assessed by Nouraie et al, reviewed 278 CT scans from patients with rhinosinusitis symptoms and noted obstructed osteo-meatal complex in 53% of patients with chronic-rhino sinusitis. CT scanning is extremely useful in confirming a clinical suspicion of chronic rhinosinusitis and features such as significant mucosal thickening, air fluid levels, OMC obstruction, or polyposis are suggestive of sinogenic disease.[10] In the present study, there was statistically significant association between right septal deviation and right maxillary sinusitis ($p<0.01$), left septal deviation and left maxillary sinusitis ($p=0.001$) and left deviation and left

ethmoid sinusitis (p=0.017). We also found association between left Haller cells and left ethmoid sinusitis (p=0.003).

Asif et al conducted a study to identify the various anatomical variations of the ostiomeatal complex in patients of chronic rhinosinusitis who underwent FESS. A total of 150 patients of chronic rhinosinusitis (medical treatment failures) who were subjected to FESS were CT scanned preoperatively to find any bony anatomic variation and the extent of mucosal disease. Concha bullosa was the commonest anatomic variation and was seen in 45 (30%) patients. In the present study also, concha bullosa (42.4%) was the most common anatomical variation, which was detected in 59 (42.4%) patients on CT PNS and DNE. The other anatomic variations noted included: paradoxical middle turbinate in 9.33% patients, uncinate process variations in 25% patients, Agger nasi cells in 9.33%, Haller cells in 8.66% and posterior septal deviations in 25.33% patients. The mucosal disease was most commonly seen in anterior ethmoids (87.33%), followed by maxillary sinus ostial area (70%), maxillary sinus disease (65.33%), posterior ethmoidal disease (38%), frontal sinus disease (15%) and sphenoid sinus mucosal disease (8.66%) patients.[11]

CONCLUSION

Anatomical variations can lead to sinonasal disease. There is a significant association between anatomical variations and pathogenesis of chronic rhinosinusitis. With the resolution of diagnostic nasal endoscopy and CT-PNS, anatomical variations can be easily identified and aid as a guide map during Functional Endoscopic Sinus Surgeries.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Deosthale NV, Khadakkar SP, Singh B, Harkare VV, Dhoke PR, Dhote KS. Anatomical variations of Nose and Paranasal Sinuses in Chronic Rhinosinusitis. PJSR. 2014;7(2):1-7.
2. Zinreich S, Kennedy D, Rosenbaum A, Gayler BW, Kumar AJ, Stammberger H. Paranasal sinuses: CT imaging requirements for endoscopic surgery. Radiology. 1987;163:769–75.
3. Bolger WE, Butzin CA, Parsons DS. Paranasal sinus bony anatomic variations and mucosal abnormalities: CT analysis for endoscopic sinus surgery. Laryngoscope. 1991;101(1):56–64.
4. Zinreich S. Imaging of infl ammatory sinus disease. Otolaryngol Clin North Am. 1993;26:535–47.
5. Brown S. Anatomy of nose and paranasal sinuses. In: Lund VJ, Stammberger H, eds. Scott Brown Otolaryngology, Basic Sciences. Volume 5. Oxford: Butterworth-Heinemann; 7th ed. 2008: 13-18.
6. Levine HL. FESS, evaluation of surgery and follow up of 250 patients. Laryngoscope. 1990;100:79–84.
7. Kirtane MV. Functional endoscopic sinus surgery (A preliminary study). Indian J Otolaryngol. 1991;43:126-9.
8. Gandotra SC, Matvani G, Kapoor R, Choudhary M. Functional Endoscopic Sinus Surgery results in 69 patients. Indian J Otolaryngol Head Neck Surg. 2000;52:5-8.
9. Berrettini S, Carabelli A, Sellari- Franceschini S, Bruschini L, Quartieri F. Perennial allergic rhinitis and chronic rhinosinusitis: correlation with rhinologic risk factors. Allergy. 1999;54(3):242-8.
10. Nouraei SA, Elisay AR, Dimarco A, Abdi R, Majidi H, et al. Variations in paranasal sinuses anatomy: implication for the pathophysiology of Chronic Rhinosinusitis and safety of endoscopic sinus surgery. J Otolaryngol Head Neck Surg. 2009;38:32-7.
11. Wani AA, Kanotra S, Lateef M, Ahmad R, Qazi SM, Ahmad S. CT scan evaluation of the anatomical variations of the ostiomeatal complex. Indian J Otolaryngol Head Neck Surg. 2009;61(3):163-8.

Cite this article as: Rajeev K, Ravishankara S, Chethana CS, Shenoy SB, Jyoti. Anatomical variations of maxillary and ethmoid sinus in chronic rhinosinusitis. Int J Otorhinolaryngol Head Neck Surg 2018;4:1008-12.