Original Research Article

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

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 otolaryngology, 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 Siemens 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 Telecom 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.

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)              |

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     | Accessory 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 sinusitis - left | 0.233            | 0.630   |
| 15   | Pneumatized uncinate – right   | Maxillary sinusitis – right    | 0.201            | 0.887   |
| 16   | Pneumatized 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 l (98%), keros 2 (2%), onodi cell (8%), Pneumatized 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. CTPNS shows fine bony anatomy of nasal paranasal sinuses.

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. 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.

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.

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.

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).

A study was assessed by Nouraie et al, reviewed 278 CT scans from patients with rhinosinusitis symptoms and noted obstructed osteo-meatall 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. 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, 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 sphenoïd sinus mucosal disease (8.66%) patients.

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 inflammatory sinus disease. Otolararyngol 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 Otolarangyol. 1991;43:126-9.
8. Gandotra SC, Matvani G, Kapoor R, Choudhary M. Functional Endoscopic Sinus Surgery results in 69 patients. Indian J Otolarangyol 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. Nouroai SA, Elisay AR, Dimarco A, Abdi R, Majdi H, et al. Variations in paranasal sinuses anatomy: implication for the pathophysiology of Chronic Rhinosinusitis and safety of endoscopic sinus surgery. J Otolarangyol 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 Otolarangyol 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 Otolarangyol Head Neck Surg 2018;4:1008-12.