ORIGINAL ARTICLE

OSTEOMEATAL COMPLEX VARIATIONS IN CHRONIC RHINOSINUSITIS PATIENTS AT A TERTIARY CARE HOSPITAL: A RETROSPECTIVE STUDY

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Background: Rhinosinusitis is one of the most prevalent mucosal diseases of the sinuses globally. The definitive treatment for this condition is functional endoscopic sinus surgery (FESS). Computed tomography (CT) scans performed before and after surgery help visualize anatomical obstructions and confirm the success of the procedure. Rhinosinusitis presents with multiple anatomical variations in the osteomeatal complex. The objective of this study was to observe various anatomical variations in sinonasal diseases. **Methods:** A retrospective study was conducted with a sample size of 95 patients who underwent FESS over a four-year period, from January 2018 to May 2022. The study included patients diagnosed with sinonasal diseases, such as everted uncinate process, concha bullosa, paradoxical middle turbinate, deviated nasal septum, agger nasi, Onodi cells, and Haller cells. CT scans performed prior to surgery were analyzed. Data was processed using SPSS version 25. **Results:** The mean age of patients was 39.0±14.0 years. The dominant age group was 20–30 years, accounting for approximately 32% of all patients. Among the 95 subjects, 68% were male and 32% female. The most common anatomical variation in the osteomeatal complex was a deviated nasal septum, observed in 43% of cases, followed by concha bullosa, reported in 27%. **Conclusion:** Preoperative CT findings provide valuable insights regarding the risk of chronic rhinosinusitis. The study identified a high prevalence of nasal septum deviation as a major anatomical obstruction in the reported cases, emphasizing its relevance in preoperative assessment.

Keywords: Chronic rhinosinusitis; Endoscopy; Nasal sinuses; Sinonasal disease; Osteomeatal complex

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INTRODUCTION

Chronic Rhino Sinusitis (CRS) is characterised by nasal congestion that disturbs the physiologic mucociliary flow in the osteomeatal complex (OMC). OMC is defined as the region that joins the frontal sinus, anterior ethmoid air cells, and maxillary sinus to the middle meatus.[1,2] chronic sinusitis is an anatomical abnormality or obstruction of the nasal mucosa. The condition persists for at least 12 consecutive weeks.[3]

The OMC presents a vital region within sinus and nasal anatomy since it provides drainage and ventilation access for frontal sinuses and anterior ethmoid sinuses and maxillary sinuses. When anatomical variations occur within this area, they can disrupt normal mucociliary clearance functions which makes individuals more susceptible to CRS. These variations include an everted uncinate process, concha bullosa, paradoxical middle turbinate, deviated nasal septum, agger nasi cells, Onodi cells, and Haller cells.[4,5] Medical research demonstrates that concha bullosa and nasal septum deviation commonly produce nasal trouble and failure of sinus drainage. The presence of such anatomical defects increases inflammation and results in long-lasting CRS symptoms which include blocked nose and facial discomfort together with mucopurulent discharge.[5]

Currently, medical professionals treat CRS by combining medical therapy with surgical procedures. Surgeons use Functional Endoscopic Sinus Surgery (FESS) to repair anatomical obstructions found throughout the OMC space. Pathological tissue removal combined with correction of structural abnormalities enables this least invasive surgical method to normalize ventilation and drainage of the sinuses.[6] FESS functions as the preferred surgical method for CRS management through its distinctive feature of selective obstruction treatment while preserving unharmed mucosal tissues.[6] CT imaging alongside other advancements have substantially improved

the process of evaluating and planning operations through FESS. CT scans produce detailed images of sinonasal structures which reveal anatomical variations that standard endoscopic exams typically fail to detect.[7–10]

CT imaging stands as the essential methodology for both CRS diagnosis and its therapeutic management. Doctors take advantage of the examination technique in two ways: it helps determine the degree of the disease and highlights key anatomical features to help medical teams avoid surgical problems. According to CT imaging, Onodi cells are posterior ethmoid air cells that present surgical risks since they are located close to important carotid artery and optic nerve components. Recurrent sinus infections can be caused on by ethmoidal Haller cells that expand into the maxillary sinus and block the infundibulum.[7,11] In order to reduce operating room difficulties and create customised surgical methods, healthcare professionals must be aware of these variances.[7]

Since OMC structural variations are common in CRS patients, preoperative assessment techniques must continue to be rigorous. In large CRS populations, anatomical differences have been found during studies in order in order to emphasise their role as risk factors for the disease's development.[4,8] Concha bullosa was shown to have an impact on a Craig research that revealed septal deviation to be present in 65% of CRS patients.[4] Finding these unique anatomical traits helps with diagnosis and surgical planning, which improves surgical success.

The primary objective of this research was to assess the anatomical variances of various sinonasal diseases. CT scans from individuals with rhinosinusitis and other conditions were used in the study to analyse sinus illnesses. In order to improve the accuracy of diagnoses and the efficiency of procedural procedures for treating afflicted patients, this study explores the anatomical abnormalities of CRS. According to the research, tailored therapy is still essential for treating CRS and enhancing the quality of life for patients.

MATERIAL AND METHODS

A retrospective study was conducted at the ENT departments of Shifa International Hospital and Shifa College of Medicine, Islamabad, from January 2018 to May 2022. A total of 95 patients over the age of 16 years with chronic rhinosinusitis (CRS) were included in the study. The WHO sample size calculator was used, with the following parameters: a 95% confidence interval, a 5% alpha error, and a population proportion of 96%. Patients diagnosed with sinus conditions other than CRS, including sinonasal or sinomucosal disease, sinonasal polyps, and pansinusitis, were included. However, patients diagnosed with fungal sinusitis or those with nasal or paranasal sinus malignancy, a history of nasal or facial trauma, or craniofacial anomalies were excluded.

Patient data was collected from hospital records after obtaining approval from the Institutional Review Board (IRB) and the hospital's ethics committee. Information gathered included patient demographics (name, gender, age), CRS diagnosis, and CT scan findings related to functional endoscopic sinus surgery. All patients underwent CT scans to assess anatomical variations, including everted uncinate process, concha bullosa, paradoxical middle turbinate, deviated nasal septum, agger nasi, Onodi cells, and Haller cells. Functional endoscopic sinus surgery was performed on all patients, with procedures carried out by a consultant ENT surgeon.

Data analysis was conducted using SPSS version 25. Basic demographic variables such as gender, age, and diagnosis were expressed as frequencies and percentages, while mean values and standard deviations were calculated for age.

RESULTS

The demographic distribution of the study sample (n=95) is summarized in Table-1. Majority of the participants were male, accounting for 68.4% (n=65) of the sample, while females made up 31.6% (n=30). Regarding age distribution, the largest group was the 20–30 years, representing 31.6% (n=30) of participants. This was followed by the 40–50 years' group at 26.3% (n=25) and the 30–40 years' group at 25.3% (n=24).

Table-2 provides an overview of the diagnostic categories among the study participants. Chronic rhinosinusitis (CR) was the most prevalent diagnosis, affecting 66.3% (n=63) of the patients. This was followed by sinonasal polyposis, which accounted for 14.7% (n=14) of cases. Other less common conditions included mucous retention cysts (4.2%, n=4), sinus mucosal disease (3.2%, n=3), and pansinusitis (3.1%, n=3). Rare diagnoses included left nasal polyposis (2.1%, n=2), antrochoanal polyp (1.1%, n=1), and maxillary sinus retention cyst (1.1%, n=1). Sinonasal disease was also identified in 4.2% (n=4) of the cases.

Table-3 summarizes the distribution of CT scan findings in the study sample of 95 patients diagnosed with chronic rhinosinusitis (CR). The most prevalent anatomical variation was deviated nasal septum, observed in 43.2% of the patients, followed by concha bullosa (27.4%), which involves pneumatization of the middle turbinate. Other significant variations included everted uncinate process (8.3%), paradoxical middle turbinate (7.4%), and agger nasi cells (7.4%). Less common findings included Haller cells (4.2%) and Onodi cells (2.1%)

(Figure-I). These variations play a crucial role in obstructing sinus drainage and contribute to the pathophysiology of chronic rhinosinusitis, highlighting the importance of preoperative CT scans in identifying potential anatomical obstructions.

Table-1: Distribution of age and gender of the study sample (n=95)

Characteristics	Frequency	Percentage
Age		
20–30	30	31.6
30–40	24	25.3
40–50	25	26.3
50–60	1	1.1
60–70	11	11.5
70–80	4	4.2
Gender		
Male	65	68.4
Female	30	31.6
Total	95	100.0

Table-2: Distribution of diagnosis of the study sample (n=95)

Diagnosis	Frequency	Percentage
Chronic rhinosinusitis (CR)	63	66.3
Sinonasal polyposis	14	14.7
Mucous retention cyst	4	4.2
Left nasal polyposis	2	2.1
Antrochoanal polyp	1	1.1
Sinus mucosal disease	3	3.2
Maxillary sinus retention cyst	1	1.1
Sinonasal disease	4	4.2
Pansinusitis	3	3.1
Total	**95**	**100.0**

Table-3: Distribution of CT scan findings of the study sample (n=95)

CT scan findings (CR)	Frequency	Percentage
Everted uncinate process	8	8.3
Concha bullosa	26	27.4
Paradoxical middle trubinate	7	7.4
Agar nasi cells	7	7.4
Haller cells	4	4.2
Onodi cells	2	2.1
Deviated nasal septum	41	43.2
Total	**95**	**100.0**

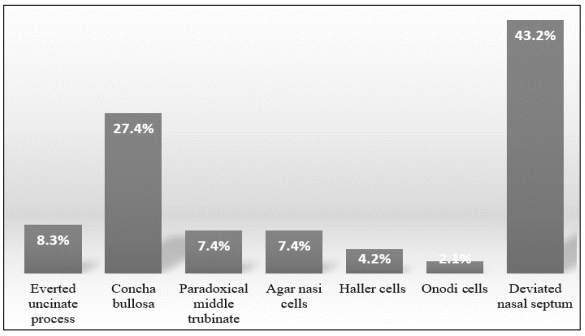

Figure-1: Frequency of anatomical variations in the CT scan findings of subjects with chronic sinusitis

DISCUSSION

The osteomeatal complex structures of patients with chronic rhinosinusitis exhibit a wide range of morphological variability, according to previous studies. The deviated nasal septum (DNS) was the most commonly found anatomical abnormality, occurring in 43% (n=41) of the cases that were investigated. According to preliminary examination, an inverted uncinate process happened in 8% (n=8) of cases, but concha bullosa alterations were seen in 27% of patients (n=26). Haller and Onodi cell forms were very rare in these patients enrolled for this study, but they did occasionally occur in conjunction with other morphological abnormalities.

These findings are supported by earlier studies. Aramani *et al.'s* experimental results showed that DNS and concha bullosa were the most common CRS variations despite Haller and Onodi cells being among the least common features.[6] The results of the current study are consistent with Kamble *et al.'s* findings regarding these anatomical variations.[1] The scientific value of anatomical variances for comprehending the pathophysiology of CRS is reinforced by research findings that show consistent patterns.

The age and gender distribution of the patients in this study resembled the results of previous studies. According to Narendrakumar *et al.,* 68% of the study population (n=65) were male patients.[11] The bulk of patients (n=30) were in the 20–30 age range, with the 40–50 and 30–40 age groups following closely behind. The age distribution of CRS patients indicates that the disease primarily affects younger and middle-aged individuals, possibly as a result of environmental exposure and human anatomy.

Distribution of patients with CRS shows the deviated nasal septum as one of the primary causes because this septum structural abnormality alters both bony and cartilaginous septum components. The displaced structures within the OMC include middle turbinate and uncinate process because of such displacement.[11] Structural blockages prevent mucociliary clearance while making users prone to persistent inflammation and frequent respiratory infections. Treatment of this condition often requires functional endoscopic sinus surgery (FESS) to eliminate symptoms while recovering the natural functions of the body. Multiple previous studies demonstrate that DNS plays an essential role in creating CRS pathogenesis due to its role in obstructive pathology.[12–12]

Both Haller and Onodi cells should receive priority attention because they carry significant risks during surgical interventions. Recurrent infections can occur because Haller cells are infraorbital ethmoid air

cells that expand into the maxillary sinus where they block the infundibulum. Onodi cells nearby the optic nerve and carotid artery create significant surgical risks for doctors performing procedures.[11] Despite their rarity the correct identification of these anomalies remains vital before surgery because it helps prevent optic nerve injuries and arterial damage during the procedure.[16] Identification guides surgical technique adaptations for optimal patient safety and surgical performance.

Concha bullosa, a sinusified middle turbinate, is commonly seen in CRS patients. This disease, when paired with OMC obstruction, causes progressive narrowing of the nasal cavity. The Concha Bullosa's presence encourages variations in air pressure, which alter nasal airflow patterns and exacerbate viral diseases and mucosal inflammation. Concha bullosa surgery improves patient health outcomes and reduces symptom relapses, according to studies.[17]

The significance of computed tomography (CT) technology for the diagnosis and treatment of CRS is shown by researchers. CT imaging provides physicians with precise information on sinonasal anatomy that would be missed by a standard-scopic examination alone.[7–10] In addition to improving performance and operational security, the pre-surgical investigation supports treatment plans created by the surgeon and tailored to each patient's needs. Anatomical evaluations and surgical planning have benefited from both three-dimensional reconstructions made possible by imaging technology advancements and other imaging technological advancements.[18]

Both the severity and onset of CRS are influenced by environmental factors and choices regarding lifestyle. Allergens, pollutants, and occupational exposures are known to exacerbate sinonasal inflammation, according to existing literature. When physicians combine surgical procedures with medical therapy approaches and environmental enhancement treatments to speed up the healing process for patients, the results are more successful.[19] A complete knowledge of the aetiology of CRS should result from future studies examining environmental causes and anatomical differences.

This research established that anatomical variations present in the OMC represent a common occurrence among patients who have CRS. The deviated nasal septum and concha bullosa as the most prevalent variations which align with studies from previous literature. The results demonstrate the need for detailed preoperative examinations especially through CT scans to achieve maximum treatment effectiveness and patient well-being improvements. Crucial for effective custom patient care clinicians must detect and handle the specific variations which exist in CRS patients. Regarding disease burden reduction and treatment strategy enhancement clinicians should factor in both environmental influences and lifestyle factors.

CONCLUSION

The study reveals that the several structural variations in the osteomeatal complex that can result in blockage and chronic rhinosinusitis, with the most prevalent being a deviated nasal septum. Prior to surgery, CT results can offer important information about the risk of persistent rhinosinusitis. To prevent any issues during the corrective surgery, a comprehensive assessment before the procedure is also essential.

AUTHORS' CONTRIBUTION

AJ: Drafting, revision, final approval. SI: Substantial contribution to the conception and design of the work. MAU, FA: Analysis, data interpretation. MS, SN: Substantial contribution to the conception and design of the work.

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