Role of Superior Turbinate Pneumatisation in Chronic Rhinosinusitis

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Abstract The study was designed (1) to study the prevalence of pneumatisation of the superior turbinate in patients undergoing FESS, (2) to evaluate the role of superior turbinate pneumatisation in sinusitis involving the posterior sinuses. The study involved 50 patients being evaluated for FESS. Pre-operative CT scans were done and reviewed by a single observer with specific attention to superior turbinates. Record was also made for opacification/mucosal thickness of the sinuses. Each side of nasal cavity was examined separately. Therefore 50 patients had 100 sides. Of the 100 sides, superior turbinate was identified in 70 sides on CT scan. Of the 70 sides having an identifiable superior turbinate, 18.6 % i.e. thirteen sides had turbinates which were pneumatised. Pneumatised superior turbinates were seen in higher percentage in patients with diseased posterior sinuses. Pneumatised superior turbinate may contribute to posterior sinus disease and mandates attention during FESS.

Keywords Superior turbinate · Pneumatisation · Chronic rhinosinusitis

Introduction

Nasal anatomy plays a significant role in the nasal physiology. The structures in the nasal walls affect the air currents in the nasal cavity [1]. The laminar flow of air currents is disturbed by variations in the anatomical

structures. It has been well documented that nasal airflow plays a role in the sinus aeration. The lack of aeration in the sinuses may predispose to the development of sinusitis. Several studies have been conducted to study the relationship between nasal anatomy, nasal airflow and its effect on nasal mucosa [2]. It is well documented that the structural anatomic variations such as pneumatisation of middle turbinate (concha bullosa) can contribute to the development of chronic rhinosinusitis by causing a blockage in the drainage pathway. Several researches have studied the role of middle turbinate and osteomeatal complex in the pathogenesis of chronic rhinosinusitis [3–7]. Though a few case reports have revealed its relation to headaches, little is known about the effect of superior turbinate pneumatisation in the etiology of sinonasal symptoms [8]. In 1991, Stammberger [9] reported a small series of patients with superior turbinate pneumatization whose symptoms warranted surgical intervention. The pneumatized superior concha was bilateral and resulted in mucosal contact-point headaches as well as anosmia/hyposmia by obstruction of the olfactory cleft. Van Alyea [3] described the prevalence of superior turbinate pneumatisation in cadaveric specimens but no correlation was made with sinusal pathology. Knowitz et al. [10] reported in their studies, the pneumatisation of superior turbinate in patients of chronic rhinosinusitis. Ariyurek et al. [11] evaluated CT scans to identify superior turbinate pneumatisation in people who had normally aerated posterior ethmoidal cells. While isolated sinusitis involving the posterior and sphenoid sinus is rare, it is theoretically possible that pneumatisation of the superior turbinate may contribute to sinonasal disease in the posterior sinuses. This becomes important as limiting the focus of endoscopic sinus surgery to the osteomeatal complex in such a patient may lead to failure of adequate drainage of the posterior sinuses leading to persistence of

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the symptoms and failure of treatment despite significant post-op morbidity.

Objectives

The objectives of this study were: (1) To study the prevalence of pneumatization of the superior turbinate in patients undergoing FESS, (2) To evaluate the role of superior turbinate pneumatization in sinusitis involving the posterior sinuses.

Materials and Methods

A study was conducted involving 50 patients who were to undergo functional endoscopic sinus surgery for treatment of their chronic rhinosinusitis. Exclusion criteria: pregnancy and lactation, inability to comply with the study, history of medical or surgical ailments, significant psychological problems, age <18 and >60 years, any patient with contraindications for surgery or radiological evaluation. Pre-operative CT scans of these patients were reviewed by a single observer. The CT scans were performed on a multislice CT Scanner–Phillips Brilliance 40 model. Study was done in spiral mode in axial plane at 1 mm intervals with coronal and sagittal reconstructions where required. CT was done at 120 kv and 30 mA with window width of 1500 and centering at 20. Field of vision used was 500. The slice thickness was between 0.67 and 0.9 mm with increment of 0.45. Both the bone window and soft tissue window were used in the scanning. While reviewing the scans specific attention was paid to the superior turbinates. The CT scans were evaluated for the presence of pneumatization of the superior turbinate and records of unilateral or bilateral pneumatization were made. The CT scans were also studied for the opacification of the sinuses for correlation of pneumatization of superior turbinate with sinus mucosal pathology.

Results

Patients were evaluated for each side of nasal cavity separately. Therefore 50 patients had 100 sides. Eight patients had pneumatization of superior turbinate i.e. 16 % patients. Of the 100 sides, superior turbinate was identified in 70 sides on CT scan. In 30 sides superior turbinate could not be identified. Of the 70 sides having an identifiable superior turbinate, 18.6 % i.e. thirteen sides had turbinates which were pneumatized. Overall 13 % of sides on CT scan had pneumatized superior turbinate. 5 (10 %) patients had bilaterally pneumatized superior turbinates. Superior

turbinate pneumatization was seen almost equally on both sides; seven on right and six on left.

Posterior ethmoid sinuses were examined and it was seen that 74 sides had mucosal changes suggestive of disease process in these sinuses. 49 (66.2 %) of these had identifiable Superior Turbinate. Of these 10 sides (13.5 %) had pneumatized superior turbinate. Twenty-nine sides had total opacification of the posterior ethmoid sinuses. Of these 29 sides showing total opacification, 4 (13.7 %) sides had pneumatized superior turbinates.

On examination of sphenoid sinus, 41 sides had mucosal changes with identifiable superior turbinate in 22 (53.6 %) sides. Total opacification was seen in 22 sides. Of the total 41 sides showing Sphenoid sinus mucosal disease, five sides (22.7 %) had pneumatized superior turbinate. Four patients (18.2 %) with total opacification had pneumatized superior turbinate.

Discussion

Chronic rhinosinusitis is a common disorder and is one of the most common reasons for the patients to seek help from a physician. Intrinsic factors of the upper airway such as anatomic variations and septal deviations can predispose to rhinosinusitis. A study by William E. Bolger demonstrated a significant association between anatomic variations and mucosal abnormalities in 220 patients of CRS [7]. The anatomic variations studied included pneumatization of the middle turbinate, paradoxical middle turbinate, Haller's cells and pneumatization of the uncinate process. Superior turbinate is a small bony projection on the lateral wall of nose [1]. It forms the superior boundary of superior meatus and contributes to the formation of sphenoethmoid recess [12]. Therefore it plays a significant role in the drainage of posterior ethmoid and sphenoid sinuses. Our study correlates the pneumatization in the superior turbinate with sinus disease.

Kanowitz et al. reported the prevalence of superior turbinate pneumatization on CT as 22 % among the people diagnosed to be suffering from chronic rhinosinusitis. In Our study the prevalence was 18.6 %. It was much less when compared to the results of Ariyurek et al. who found pneumatization in 48 % superior turbinates. Also, Van Alyea described pneumatization of the superior turbinate in his study of the ethmoid labyrinth in 100 midsagittal cadaveric specimens. Under direct vision, he identified a superior turbinate in 67 specimens. He found pneumatization of superior turbinate in 57 % cadaveric specimens (38 out of the 67 identified superior turbinates). However, no correlation was made with finding of sinus disease.

However Ariyurek et al. retrospectively evaluated CT scans of those patients who had normally aerated posterior

ethmoidal cells and an unobscured nasal cavity. Our results may have been affected by the fact that in our study we could not identify superior turbinate in 30 sides. As was also argued by Kanowitz et al., the reason for this could be the presence of nasal polyps in our patients with chronic rhinosinusitis which obscured the presence of some pneumatized superior turbinates. There may be an inherent failure to identify minimally pneumatized superior turbinate on conventional CT scans as opposed to direct visualization by Van Alyea.

Our study found bilaterally pneumatized superior turbinate in 10 % cases. Airyurek et al. found bilaterally pneumatized superior turbinates in 15 % and Kanowitz et al. in 17 %. Kanowitz et al. found pneumatization more common on the left side. However our study did not find any such distinction as it was distributed equally on both the sides.

Our study found that there was a significant relation in the prevalence of superior turbinate and its pneumatization in the patients showing radiological signs of disease in the posterior ethmoids and sphenoid sinuses. Further studies are required to establish relation between superior turbinate pneumatization and chronic rhinosinusitis.

Compliance with Ethical Standards

Conflict of interest Neha Verma and Pankaj Kumar declare that they have no conflict of interest.

Ethical Standard Permission to conduct the above study was obtained prior to the start of the study by The Ethical Committee of the hospital of affiliation of the authors. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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