Anatomical Variations in Sino-Nasal Region: A Computer Tomography (CT) Study

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Abstract

Objective: The aim of this study is to report the frequency of anatomical variations in the sinonasal region in adult Jordanian patients.

Patients and Methods: This study was performed between April to November 2006 in the Department of Otolaryngology, King Abdullah University Hospital, Irbid, Jordan .110 consecutive nasal and paranasal sinus Computer Tomography (CT) for adult patients with nasal symptoms were reviewed for the presence of agger nasi cell, paradoxical middle turbinate, haller cell, and nasal septum deviation. We also report the incidence of pneumatisation in Crista galli, nasal septum, middle and superior turbinate as well as uncinate process.

Results: There were 58 males and 52 females with an average age of 34 (age ranges from 16-77). Agger nasi cell was the most common variant and was observed in 84% of the cases, Concha Bullosa (CB) in 62%, Septal deviation in 43%. Pneumatization of Crista galli, Septum, Superior turbinate and Uncinate process was seen in 28%, 27%, 25% and 6%, respectively. Haller's cell was noted in 20% and paradoxical middle turbinate in 18%.

Conclusion: Anatomical variations in sinonasal region are common in our patients with nasal symptoms and seem to be more frequent than those reported by other races. This emphasizes the importance of adequate preoperative and intraoperative review of paranasal sinus CT scans in patients undergoing ESS to avoid the potential of serious surgical complications.

Keywords: Sino-Nasal Region, Anatomical Variations, and Computer Tomography.

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Introduction

CT of the paranasal sinuses has become the test of choice for the radiological diagnosis of Chronic Rhinosinusitis (CRS). [1] Unlike plain radiography, sinus CT provides excellent anatomical soft tissue and bony details, objective evidence for the diagnosis and staging, close image in correlation to the surgical field, and an important "roadmap" to paranasal sinus anatomy should surgery be considered.

Although the role of anatomical variations at Osteomeatal complex in the etiology of CRS is

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controversial, [2] proper knowledge of these variations is essential for conducting ESS when the approach has to be modified to minimize serious complications during surgery. Additionally, the frequency of these variations may differ among the different ethnic groups. [3] Review of literature coming from the Middle East region revealed only a handful of studies addressing this issue.

The aim of this study is to report the frequency of these variations in adult Jordanian patients with Sino-Nasal symptoms.

Method

The consecutive nasal and paranasal sinus CT scans of a 110 patients who attended Otolaryngology clinic at King Abdullah University Hospital (Irbid, Jordan) between April 2006-November 2006 were analyzed. All patients had the CT scan for evaluation of symptoms referable to the sinonasal region. CT Scans with gross disease, of a patient under the age of 16, who underwent previous sinonasal surgery, or with sinonasal neoplasm or facial trauma were excluded. The CT plane was Direct Coronal with 5 mm thickness obtained from glabella to the posterior wall of the sphenoid sinus without using intravenous contrast and performed while the patient is in prone position with neck extension.

The author reviewed each CT scan in two different occasions and reported the results in separate data sheets. When a discrepancy existed between the two readings, a radiologist opinion was considered. Each lateral nasal wall of one patient was reviewed for the presence of agger nasi cell, haller's cell, paradoxical middle turbinate and more than 3 mm nasal septum deviation. Additionally, the frequency of pneumatization in crista galli, nasal septum, superior and middle turbinate, and uncinate process are reported.

Result

The mean age of the patients included in the study was 34 and their ages varied from 16 to 77 years. There were 52 females (47%) and 58 males (53%) that took part in the study. Agger nasi cell was the most common variation and was observed in 92 patients, in (80%) the cell was observed on both sides. CB was the second most common variant observed in 62 % of the patients and was usually seen on one side of the lateral nasal wall. A total of 47 (43%) patients had Nasal Septum Deviation (NSD) of 3mm or more, 26 to right and 21 to left side. Pneumatization of the posterior nasal septum was observed in 30 patients. Other site of pneumatization was seen in crista galli in 31 patients, in superior turbinate in 27 patients and in uncinate process in 7 patients. Haller's cell and paradoxical middle turbinate were seen in 22 and 20 patients, respectively (Table 1).

Table (1): Anatomical variations of sinonasal region of 110 patients.

Side of sinus				***Patient 110***	
	R	***L***	***B***	***No***	***%***
Aqaer nasi	*10*	*8*	*74*	*92*	*84*
Concha bullosa of middle turbinate	*19*	*21*	*28*	*68*	*62*
Paradoxical middle turbinate	*4*	*9*	*7*	*20*	*18*
Haller cell	*8*	*7*	*7*	*22*	*20*
Pneumatization of superior turbinate	*12*	*8*	*7*	*27*	*25*
Pneumatization of uncinate process	*3*	*4*	*0*	*7*	*6*
Septal deviation >3mm	*26*	*21*		*47*	*43*
Pneumatization of posterior septum				*30*	*27*
Pneumatization of crista galle				*31*	*28*

Discussion

The surgical management of CRS and nasal polyposis has evolved over the years. External facial incisions, extensive nasal packing and prolonged hospital stays have been replaced by minimally invasive surgery. This involves opening the obstructed ostia to provide normal ventilation with preservation of adjacent mucosa. [4, 5] While excellent results have been reported in the literature to date, [6, 7] given the close relation of the paranasal sinuses to important structures such as the orbit and skull base, if complications occur in surgery, they are usually dangerous and harmful.

Anatomical variations in the sinonasal region are common. Recent advances in CT scanning and the widespread of ESS, as well as the presence of universal agreement in the variation nomenclature and terminology has made the extent of these variations apparent. Although their role in the development of sinusitis remains unclear, surgical procedures should be tailored for most of these special conditions.

Badia et al. [3] reviewed the CT scans of a 100 Caucasian and a 100 Chinese patients and found significant difference in the occurrence of CB, paradoxical middle turbinate, haller's and onodi cell between the two groups. Pneumatization of the agger nasi cell was the most common variant in both groups. Their results may explain in part the wide variations in sinonasal anatomy reported in the literature.

In our study, we noted a higher frequency of these variations in comparison to previous reports of Caucasian, Asian, Chinese and Indian races (Table 2). This might be explained by selection and CT scan bias; however, we can't ignore genetic and environmental factors.

Agger nasi cell (Fig. 1) is a reminant ethmoturbinal and represents the most anterior ethmoid cell usually lying deep to the lacrimal bone and borders the primary ostium or the floor of the frontal sinus. Its size may directly influence the patency of the frontal recess and the anterior middle meatus. [8] It was the most common variant observed in our study and was present in the majority of cases in both lateral nasal walls. Perez-Pinas et al. [9] reviewed 110 CT scan of patients suspected of inflammatory sinus pathology and found agger nasi in all cases studied. Wormald [10] considered this cell as the key to understanding the complex anatomical configuration of the frontal recess. Since this cell has an intimate relationship to the lacrimal sac and orbit, infection in this cell can result in ocular disease and visual symptoms.

Middle turbinate CB (Fig. 2) is referred to as pneumatization of the middle turbinate by extension from the anterior ethmoid cells or less frequently, posterior ones. [11] The reported prevalence of CB varies widely from 14-80%, [2] with some authors only considering pneumatization of the vertical lamina and the inferior bulb of the middle turbinate as true concha. In this study, we consider aeration in either site as CB. We believe adapting this definition will minimize the wide range of variations by eliminating interpersonal inclusion and exclusion criteria. The CB in itself does not require surgery, but the presence of a CB may predispose a patient to occlusion of the ostiomeatal complex and subsequent sinus disease.

We observed septal deviation in 47 patients (43%) with slight predominant to the right side. NSD may induce CRS by mechanical, aerodynamic or alteration of sinusal ventilation and antral pressure. [9, 12] Air cells are commonly found within the posterior portion of the nasal septum, (Fig. 3) and communicate with the sphenoid sinus allowing infection of the paranasal sinus spread to these cells. [8] Additionally, if these cells are prominent, they may block the drainage of the middle meatus.

Haller's cell (Infraorbital ethmoid cell) was first identified by Haller in 1765 and subsequently named after him. Haller's cell often arise from the anterior ethmoid cells as either a single cell or multiple cells (Fig. 2) and projects along the medial roof of the maxillary sinus and the most inferior portion of the lamina papyracea below the ethmoid bulla and lateral to the uncinate

process and so they are closely related to the infundibulum. Although its proximity to the natural ostium of the maxillary sinus, Bolger, [11] Lloyd, [13] Zinreich [14] and Earnwaker [15] found no significant correlation between Haller's cell and chronic sinus disease.

Paradoxical middle turbinate is a laterally projected curvature of middle turbinate, which may lead to narrowing of the middle meatus (Fig. 4). Stammberger and Wolf [16] accepted paradoxical curvature of the middle turbinate as an etiologic factor for CRS because it may cause obliteration or alteration in nasal air flow dynamics.

While anatomical and clinical studies about superior turbinate are relatively uncommon, we agree with Ariyurek et al. [17] that the pneumatization of superior turbinate (Fig. 5) is not infrequent and should be taken into account when evaluating the CT scan of paranasal sinuses. Large concha may cause contact headache, hyposmia and sphenoiditis by obstructing sinus ostium. In these cases, careful partial surgical reduction will relieve patient's symptoms.

Pneumatization of the uncinate process (Fig. 6) is believed to be due to the extension of the agger nasi cell within the anterosuperior portion of the uncinate process. It has also been suggested as a predisposing factor for impaired ventilation of the anterior group of sinuses and frontal sinus. The reported incidence in literature ranges from 0.4 to 18 % [8] and was found to be the least common variant in our studied patients.

Table (2): Reported incidence of sinonasal anatomical variations in different ethnic population.

Authors & Country	*No. of lateral nasal wall*	*Agger nasi*	*Concha Bullosa*	*Paradoxical middle turbinate*	*Haller's cell*	*NSD*
Lerdlum & Vachiranubhap[18] (Thiland)	*266*	*7.9%*	*14.3%*	*5.3%*	*9.4%*	*56%*
Dua et al. [19] (India)	*100*	*40%*	*11%*	*7%*	*12%*	*44%*
Kim et al.[20] (Korea)	*226*	*66%*	*19%*	*11%*	*30%*	*44%*
Badia et al. [3] (Honk Kong)	*200*	*52%*	*9.5%*	*6.5%*	*5%*	*15%*
Badia et al.[3] (UK)	*200*	*54%*	*28%*	*20%*	*14%*	*33%*
Sivaslı et al.[21] (Turkey)	*94*	*15%*	*42%*	*3%*	*22%*	
Perez-Pinas et al. [9] (Spain)	*220*	*100%*	*15%*	*5%*	*4%*	*58%*
Caughey et al [22] (USA)	*500*		*27.4%*		*27%*	
Present study	*220*	*76%*	*44%*	*12%*	*13%*	*43%*

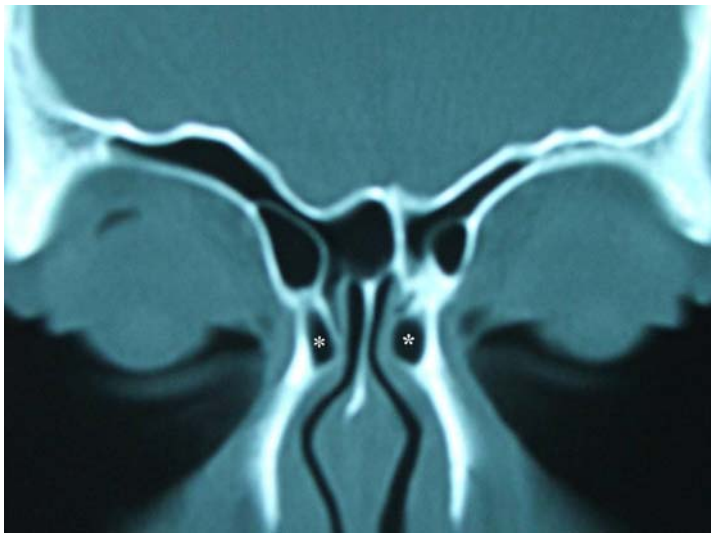

Figure (1): Coronal CT section showing bilateral agger nasi cell (white star).

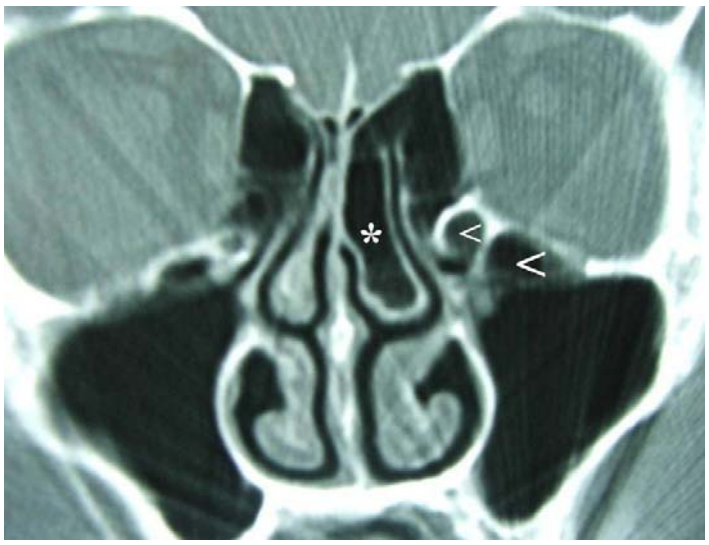

Figure (2): Middle Turbinate Concha Bullosa on the left side (white star) and two Haller's cells on the same side (<).

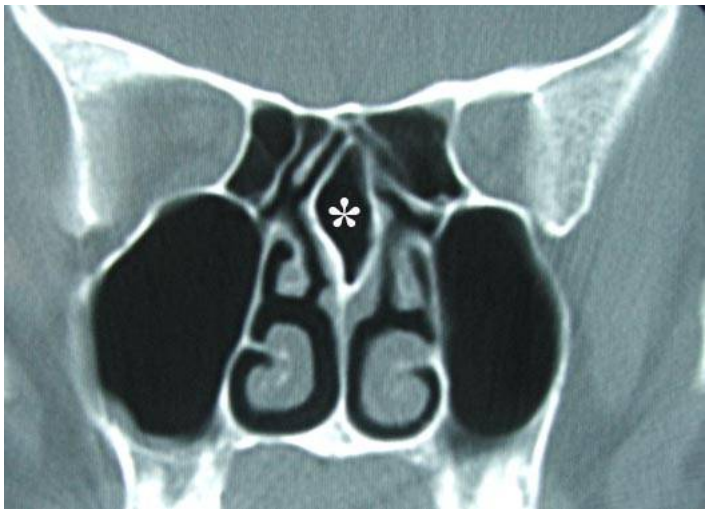

Figure (3): Pneumatization of the perpendicular plate of the ethmoid plate (white star).

Figure (4): Bilateral paradoxical middle turbinate (arrowheads).

Figure (5): Pneumatization of the right superior turbinate (white star).

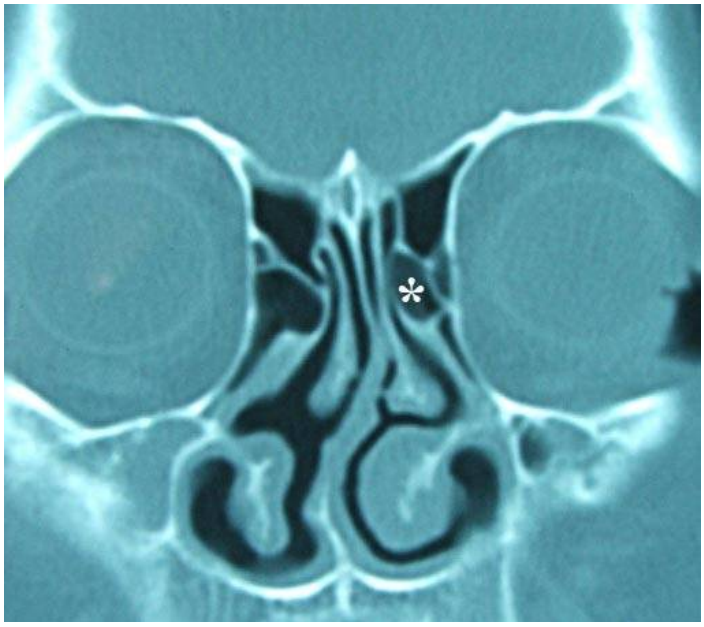

Figure (6): Pneumatization of the left uncinate process (white star) with ipsilateral nasal septum deviation.

Conclusion

Anatomical variations in sinonasal region are common in our patients. Although these variations do not differ between symptomatic and asymptomatic populations, they may differ between different ethnic groups. More studies with larger number of patients are needed to further verify this.

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الاختلافات التشريحية في منطقة الأنف والجيوب الأنفية: دراسة بالتصوير المقطعي

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الملخص

الهدف: تهدف هذه الدراسة إلى تحديد نسبة الإختلافات التشريحية في منطقة الأنف والجيوب الأنفية لدى المرضى الأردنيين البالغين.

الطرق: أجريت هذه الدراسة في قسم الأنف والأذن والحنجرة في مستشفى الملك عبدالله الجامعي إربد، الأردن، بين شهري نيسان –تشرين الثاني 2006م. (110) صورمقطعية متتالية لمرضى بالغين تمت مراجعتها لوجود خلية النابرة الأنفية، متضادة القرنية المتوسطة، خلية هلر وإنحراف الحاجز الأنفي. وكذلك لوجود خلايا هوائية في الحاجز الأنفي، القرنية العلوية والمتوسطة، وفي الناتئة المعقوفة.

النتائج: كان هناك (58) رجلاً و(52) إمرأة بعمر متوسط (34) سنة (16– 77). خلية النابرة الأنفية كانت اكثر المتغيرات شيوعاً ولوحظت في (84%) من الحالات، وجود خلية هوائية في القرنية المتوسطة في (62%)، إنحراف حاجز الأنف في (43%). اما نسبة وجود خلايا هوائية في الحاجز الأنفي، القرنية العلوية، وفي الناتئة المعقوفة فكانت 27%، 25% و6% على التوالي.

الخاتمة: الإختلافات التشريحية في منطقة الأنف والجيوب الأنفية شائعة في المرضى الذين يشكون من أعراض أنفية، وتبدو وكأنها أكثر شيوعاً من تلك المسجلة في الأجناس الأخرى. هذا يؤكد أهمية مراجعة الصور الشعاعية جيداً قبل وأثناء إجراء عمليات الجيوب الأنفية بالمنظار.

الكلمات الدالة: منطقة الأنف والجيوب الأنفية، الاختلافات التشريحية، صور مقطعية.