ANATOMIC VARIATIONS OF THE MIDDLE MEATUS IN PATIENTS WITH SINUSITIS

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SUMMARY : In order to investigate the obstructive anatomic malformations of the ostiomeatal complex area in patients with chronic/recurrent sinusitis, a total of 113 patients were evaluated preoperatively going through a nasal endoscopy and high resolution computed tomographic (CT) imaging in coronal plane. The anterior ethmoidal cells were the commonest effected area of the paranasal sinuses in our patients. Furthermore, in patients with symptomatic sinusitis a high incidence of (85.44 %) obstructive anatomic malformations such as concha bullosa and overpneumatized bulla ethmoidale were observed. These results show that obstructive malformations of the middle meatus play a major role in the pathophysiology of chronic /recurrent sinusitis.

Key Words : *Chronic Sinusitis, Anterior Ethmoid, Nasal Endoscopy, Computerized Tomography.*

INTRODUCTION

In order to perform a complete examination of the nasal cavity, Hirschmann (1901) modified a cystoscope, thereby introducing the idea of nasal endoscopy. Many authors worked on this subject, but it was not until 1978 when Messerklinger and Terrier have independently defined nasal and paranasal sinus endoscopy in a systematic and detailed manner (Messerklinger, 1978; Gustafson and Kern, 1989).

When the importance of pathologies of the middle meatus and the anterior ethmoid region were identified as "key area" in the pathophysiology of sinusitis, it was found out that conventional diagnostic methods were not satisfactory (Stammberger and Posawetz, 1990). At present, endoscopic examination and a CT in coronal plane together are utilized in order to determine the middle meatus and the anterior ethmoid region pathologies, when evluating patients with chronic/recurrent sinusitis. Endoscopy identifies the nature of the pathology and CT shows the extent of the disease (Chow and Mafee, 1989; Jorgensen, 1991).

Middle meatus pathologies in patients with sinusitis are either soft-tissue pathologies e.g., polyps or hypertrophic mucosa, or variations of normal anatomic structures. These anatomic variations may include septal deviation/spurs, middle turbinate malformations (concha bullosa, paradoxicaly curved middle turbinate), malformations of uncinate process (medially or laterally bent uncinate process, pneumatized uncinate process), overpneumatized bulla ethmoidale, Haller's cells and agger nasi cells. These anatomic malformations may be found in combination of two or more or they may be solitary (Stammberger and Wolf, 1988).

In the presence of obstructive malformations of the ostiomeatal complex area, the ostia may be obstructed completely or narrowed partially. In ostiums of normal size, minimal mucosal reactions (as in vasomotor reations) do not cause obstruction, but on the other hand in subjects with narrowing malformation of the middle meatus, obstruction of the ostium takes place resulting in sinus infection (Stammberger, 1991).

In our study, the preoperative assesment of patients with chronic/recurrent sinusitis is based upon a combination of nasal endoscopy and CT imaging in order to investigate the extent of the infection and to diagnose the types of anatomic variations in the middle meatus and the anterior ethmoid area that cause infection.

MATERIALS AND METHODS

A total of 113 patients with chronic/recurrent sinusitis underwent evaluation at Ankara Numune State Hospital Otolaryngology Clinic from December 1989 through July 1991. Patient age, sex, medical history and physical examination findings were recorded. Conventional x-rays such as Waters and Caldwell were obtained prior to nasal endoscopic examination and computerized tomographic imaging.

0° and 30° rigid endoscopes of Karl Storz with 2.7 mm and 4 mm diameter were used. The patients were evaluated under local anesthesia and in supine position. Topical anesthesia of the nasal mucosa was performed in the form of spray or blower, so as to preserve the natural appearance of the nasal mucosa and pathologic secretions. When nasal endoscopy was performed, the structures evaluated in each case included floor of the nasal cavity, septum, inferior meatus and orifice of the nasolacrimal duct, inferior turbinate, nasopharynx, sphenoethmoidal recess, ostium of the sphenoid sinus. Furthermore, following medially displacement of the middle turbinate, middle meatus, uncinate process, bulla ethmoidale, frontal recess, if visible, ostium of the maxillary sinus, also, if present, the accessory ostium of the maxillary sinus were evaluated. To be able to evaluate the interior of the maxillary sinus, with the help of a special trocar antral wall was punctured through fossa canina, preceded by sublabial infiltrative anesthesia. Atraumatic suction probe was used to aspirate the contents of the sinus and then the interior evaluation of the sinus was achieved with the help of an endoscope through the cannula of the trocar.

Following endoscopic examination computerized tomographic imaging were performed on Picker International 1200 SX Unit at University of Ankara, Medical Faculty, Department of Radiology. CT imaging was recorded in a period when the patient was either asymptomatic or had minimal symptoms. Data were acquired in the coronal plane CT imaging without the use of IV contrast. The CT protocol is shown in Table I.

Patient's position	: Prone, head hyperextended
Algorithm	: High resolution
Slice thickness	: 3 mm
Slice interval	: No gap before infundibulum, 3 mm after infundibulum
Position	: Coronal (perpendiculer to IOML*)
Window width / Window center : 4000 / 1200	
130 kV, 95 m A, 6.16 sec. scanning time	
512x512 matrix	
Special resolution : 151 1g/cm	
* : IOML : Infraorbitomeatal line	

Table - 1 : CT protocol used in evaluation of paranasal sinuses.

RESULTS

Out of 113 patients with sinusitis, 48 were male and 65 were female. Patients, age ranged from 18 to 63, average patient age was 34. All patients came from all parts of Turkey, no area predominating. All patients had undergone medical treatment previously without benefit. Distribution of paranasal sinus disease in 113 patients with chronic/recurrent sinusitis is given in Table II.

	No	%
Anterior ethmoid	80	70.80
Maxillary	59	52.21
Frontal	32	28.32
Posterior ethmoid	20	17.70
Sphenoid	16	14.16

Table - 2 : CT distribution of paranasal sinus disease in 113 patients with chronic/recurrent sinusitis.

From an initial study group of 113 patients 10 patients were eliminated due to massive polyposis or previous operations causing changes in the middle meatus and the anterior ethmoid anatomy. Middle meatus variations were evaluated in the final study group comprising 103 patients. Obstructive anatomic malformations of the middle meatus and anterior ethmoid are were detected in 88 (85.44

%) of 103 patients following nasal endoscopy and high resolution LI evaluation. In our series the distribution of anatomic variations predisposing to chronic/recurrent sinusitis is shown in Table III.

	No	%
Septal deviation/spurs	17	19.32
Concha bullosa	38	43.18
Paradoxically curved middle turbinate	7	7.95
Medially/laterally bent uncinate process	10	11.36
Pneumatized uncinate process	6	6.81
Overpneumatized bulla ethmoidale	23	26.14
Haller's cells	8	9.09
Agger nasi cells	46	52.27

Table - 3 : Distribution of anatomic variants predisposing to chronic/recurrent sinusitis (No. patients = 88).

DISCUSSION AND CONCLUSION

Evaluation of patients with chronic/recurrent sinusitis in our clinic, revealed that the most frequently involved sinus area was the anterior ethmoid cells (70.8 %). This evaluation confirms the results reported earlier by other investigators (Bolger et al. 1991; Stammberger and Wolf, 1988; Zinreich et al. 1987). Havas et al. (1988) also have observed that the commonest localization of the asymptomatic sinus infection was the ethmoid region. This suggests, that the anterior ethmoid region is in fact a "key area" in the pathophysiology of the paranasal sinus infection (Stammberger and Posawetz, 1990).

We have detected anatomic variations causing stenosis or obstruction of the middle meatus in 85.44 % of our patients. Bolger et al (1991) in their series of 202 cases, reported the incidence of anatomic variations of the middle meatus as 64.9 %. The high incidence of such malformations in patients with sinusitis supports Messerklinger's conclusion that the cause of recurrent sinus infections is in fact on obstruction or stenosis in the ostium area of the related sinus (Stammberger, 1986).

In our study, more frequently encountered anatomic variants of the middle meatus were agger nasi cells (52.27 %), concha bullosa (43.18 %), overpneumatized buulla ethmoidale (26.14 %) and septal deviation/spurs (19.32 %).

Agger nasi cells are found in front of the frontal recess. They may be pneumatized to various degrees and when overpneumatized may cause narrowing of the frontal recess, resulting in frontal sinus infection (Fig 1) (Stammberger and Wolf, 1988).

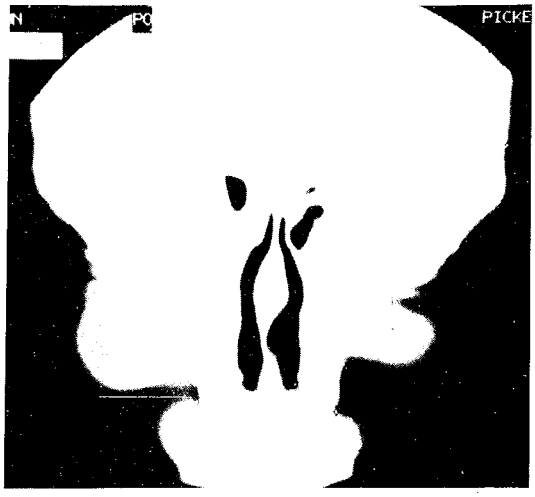

Fig. 1 : Bilateral larger agger nasi cells leading to impairment of the frontal sinus drainage.

Pneumatization of the middle turbinate, is termed as "concha bullosa" (Zinreich et al. 1988). Bolger et al. (1991) classified concha bullosa into three different types : lamellar, bulbous and extensive. But we have gathered all types of concha bullosa under one group (Fig 2, 4). We observed concha bullosa in 38 of our cases (43.18 %). In 17 patients (44.74 %) bilateral concha bullosa and in 21 cases (55.26 %) unilateral concha bullosa was detected. In a total of fifty-five middle turbinates of bullous nature, we have shown them to open into the frontal recess in twenty-two cases (40 %), fourteen of them opened into the hiatus semilunaris (25.45 %) and

Fig. 2 : A case of "giant" concha bullosa completely filling the left nasal cavity and displacing the inferior turbinate laterally.

nineteen (34.45 %) opened in to the anterior ethmoidal cells.

Bulla ethmoidale forms the postero-superior margin of the semilunar hiatus. The ethmoid bulla may narrow or completely obstruct the ethmoidal infundibulum when larger than normal (Fig 3). Occasionally, it can be pneumatized to such a degree that it may protrude from the middle meatus like a "mushroom" (Stammberger and Wolf, 1988).

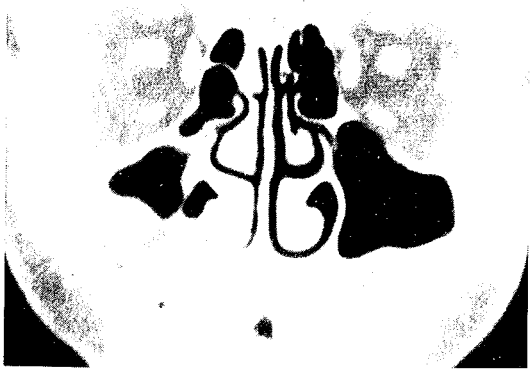

Fig. 3: A patient previously operated on the right side (Caldwell-Luc). Although the inferior meatal window is patent, patient's complaints along with the obstruction of the ethmoidal infundibulum and the maxillary sinus ostium by the overpneumatized low hanging bulla ethmoidale continues. On the same side, collection of secretion can be seen in the superior meatus.

Septal deviation/spurs may lead to poor ventilation and secretin retention by narrowing the nasal cavity and the middle meatus (Stammberger, 1991). In patients with sinusitis, if a deviation narrows the nasal cavity, preventing the passage of endoscope of 4 mm diameter, a septosplasty operation is performed 4 to 6 weeks prior to the sinus operation. In our study, in patients with septal deviations, we have observed obstructive malformations in the midle meatus, either on the same or contralateral side (Fig 4).

Another malformation encountered less frequently in this study, was paradoxically curved middle turbinate accompanied by other malformations rather than bening an isolated malformation. Although it is relatively easy to diagnose the uncinate process malformations, such as laterally/medially bent uncinate process, by endoscopic examination, the diagnosis of the pneumatized uncinate process could be made only on the basis of CT imaging (Fig 5). Haller's cells were identified during sublabial si-

Fig. 4: A septal deviation narrowing the left nasal cavity and the middle meatus. However, more significant is the complete obstruction of the ethmoidal infundibulum due to an anatomic variant (concha bullosa) in the middle meatus of the contralateral side in association with mucosal thickening of the maxillary sinus.

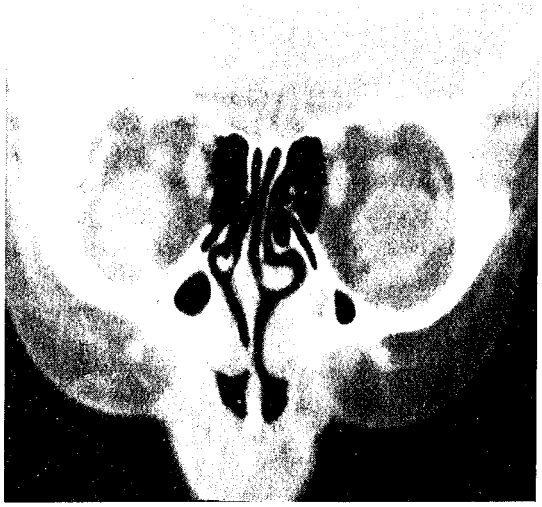

Fig. 5: A case of pneumatized uncinate process of the left side.

noscopy and CT imaging. However, it should be recognized as a seperate entity than "low hanging bulla ethmoidale" (Bolger et al. 1991). We have found it to be a malformation which directly narrows the maxillary sinus ostium (Fig 6).

Bolger et al. (1991) reported that in their series such malformations were encountered in the following frequencies : agger nasi cells in 98.5 %, concha bullosa in 53 %, Haller's cells in 45.1 %, paradoxically curved middle turbinate in 26.1 %, pneumatized uncinate process in 2.5 % of patients.

In his series, Calhoun et al (1990) has reported

Fig. 6: Complete opacification of the maxillary sinus of the right side is seen and on the contralateral side (left), the ethmoidal infundibulum and the maxillary sinus ostium is narrowed from above and behind by a Haller's cell.

that in sinus-symptomatic patients the frequency of ostiomeatal complex disease was significant (61.9 %).

Although Lloyd (1990) believes that ostiomeatal complex anomalies do not play a role in the etiopathogenesis of sinusitis, he observed asymptomatic sinus infections to be most common in anterior ethmoid cells. Furthermore, he showed concha bullosa to be associated with the presence of increased infection in the sinuses (85 %).

A review of the literature and also our results support the concept that middle meatus and anterior ethmoid area are reservoirs of infection in patients with sinusitis, and the clefts, such as ethmoidal infundibulum and frontal recess which drain the major sinuses, are narrowed by the obstructive anatomic variants of the middle meatus thus, resulting in a secondary infection of the larger adjacent sinuses (Stammberger and Wolf, 1988; Stammberger and Posawetz, 1990; Stammberger, 1991). For this reason, endoscopic examination should be performed routinely in all patients with nasal complaints, to evaluate the ostiomeatal complex region. This is not only a diagnostic evaluation but is also an important guide for planning the operative procedure. When non-physiologic "alternative windows", such as inferior meatal antrostomy are performed, a complete recovery should not be expected since obstructive anatomic variants continue to contribute to the middle meatal blockage.

In conclusion, the procedure to be followed in patients with chronic/recurrent sinusitis is to perform nasal endoscopy and CT imaging in order to determine the extent of infection and obstructive variants in the ostiomeatal complex area. Additionally, with the contribution of this diagnostic examination and imaging, the most suitable surgical, procedure, which at present is Functional Endoscopic Sinus Surgery, can be performed to eradicate the true reservoir of infection in the middle meatus and the anterior ethmoid region, therewith providing normal ventilation of the affected major sinuses through their natural ostia.

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