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Paranasal Sinus Anatomic Variations Accompanying Maxillary Sinus Retention Cysts: A Radiological Analysis

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Original Investigation

Abstract

Objective: The risk factors for the development of retention cysts of the maxillary sinuses (RCMs) are not clear, although RCMs are common findings on radiographic images. This study was conducted to evaluate the correlation between RCMs and other nasal-paranasal anomalies and to demonstrate the possible effects of these anomalies on the development of RCMs.

Methods: In the study, paranasal sinus computerized tomography (PNsCT) images from 5166 patients were retrospectively reviewed. Correlations between RCMs and osteomeatal complex obstruction, accessory ostium presence, abnormalities of the middle turbinate, and nasal septal deviation were analyzed in the PNsCT images. The paranasal sinus anomalies on the side of the RCMs were compared to the contralateral side.

Results: A total of 1880 RCMs were detected in 1429 (27.6%) of 5166 patients. At least one nasal-paranasal sinus anomaly was associated with 88.7% of the RCMs. In the descending order, accessory ostium presence, accessory ostium, middle turbinate anomalies, and nasal septal deviation are pathologies that accompany RCMs. When unilateral RCMs were compared with the normal side, significant correlations were observed between RCMs and osteomeatal complex obstruction, accessory ostium, and middle turbinate anomalies (p=0.001, p=0.016, and p=0.03, respectively). RCMs were commonly found on the same side as osteomeatal complex obstruction (p=0.001), middle turbinate anomalies (p=0.001), and accessory ostium (p=0.052).

Conclusions: In this study, the coexistence of osteomeatal complex obstruction, accessory ostium, middle turbinate anomalies, and nasal septum deviation with RCMs was analyzed by investigating PNsCT findings in 5166 patients. The results show that RCMs are associated with pathologies that increase paranasal inflammation, such as osteomeatal complex obstruction, and are good markers for nasal-paranasal sinus anomalies. The presence of incidental RCMs should be a warning sign of nasal-paranasal sinus anomalies.

Keywords: Paranasal sinuses, anomalies, nasal cavity, turbinates, computed tomography

Introduction

Retention cysts of the maxillary sinuses (RCMs) generally appear as dome-shaped, rounded, soft tissue masses, mostly on the floor of the maxillary sinus. Obstruction of the ducts of the seromucous glands is thought to induce the development of retention cysts. Consequently, RCMs are lined by epithelium and contain mucous or serous fluid (1). The most common locations of these mucosal cysts are ethmoid and frontal sinuses, while 10% are in the maxillary sinuses (2). The reported prevalence of RCMs in the general population ranges from 3.2% to 35.6% (3). It is often believed that RCMs are a self-limiting situation, with spontaneous regression and disappearance rates of 17.6%-38% (1). However, recent studies have declared a relation between RCMs and symptoms, such as nasal obstruction, headache, facial pain in the sinus areas, nasal discharge, and postnasal drip (4).

Paranasal sinus computed tomography (PNsCT) can generally distinguish RCMs from the other forms of maxillary sinus pathologies (5, 6). The cysts are the most common incidental findings in the maxillary sinuses (7). In addition, PNsCT is more valuable for detecting accompanying pathology or anatomical abnormalities than for scoring paranasal sinus inflammation (7-9).

This study determined the importance of incidental RCMs in an asymptomatic population by

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analyzing the relationship between RCMs and nasal-paranasal sinus abnormalities through PNsCT images.

Methods

This retrospective study was approved by the ethics committee of a tertiary referral center (no. 2015/2-27).

This study reviewed PNsCT images of the paranasal sinuses obtained from 8000 consecutive patients between September 2007 and November 2015 who were evaluated for nasal obstruction, rhinorrhea, headache, chronic otitis media, facial pain, and facial trauma. Patients with acute sinusitis, nasal polyposis and masses, and anatomical defects secondary to previous surgery according to the PNsCT scan were excluded. In total, 5166 patients were enrolled into the study. All the PNsCT examinations were performed using a 64-slice CT scanner (Aquilion 64; Toshiba Medical Systems, Tochigi, Japan) with 0.5 mm collimation, 120 kV, and 150 mAs. Coronal, axial, and sagittal reformatted images in 2-mm slice thicknesses were evaluated in the bone window. When necessary, additional reformatted images were obtained. All examinations were reviewed by an otolaryngologist and a radiologist in consensus to differentiate abnormalities.

The presence of RCMs, osteomeatal complex obstruction (OMCO), an accessory ostium, and abnormalities of the middle turbinate (AMT) were evaluated independently for the right and left sides. Nasal septum deviation (NSD) was assumed to disrupt the normal physiology in both nasal passages and evaluated as abnormal for both sides (10). The diagnosis of RCMs was confirmed using the following criteria: (1) a uniformly dense, homogeneous, spherical or dome-shaped shadow arising from the wall or floor of the maxillary sinus with the demarcation of the lateral borders >5 mm in the longest dimension; (2) no bony destruction; (3) no association with tooth roots (to exclude dentigerous cysts); and (4) a spherical and smooth outline along the free border (4).

Defects in the fontanel area of the lateral nasal wall observed in both axial and coronal PNsCT images were interpreted as an accessory ostium. An accessory ostium is rounder than the natural ostium and the size ranges from 1.2×1.0 to 8.2×6.9 mm (11). Accessory openings detected in the axial and coronal images were accepted as accessory ostium. Bony anatomic variation of the middle meatus including pneumatization, paradoxical curvature, and bifid concha, was noted as middle turbinate pathology. NSD was defined as a shift of the nasal septum >3 mm from the midline. Figure 1 demonstrates some paranasal sinus anatomic variations accompanying maxillary sinus retention cysts.

Statistical analysis

All data were analyzed using the Statistical Package for the Social Sciences, version 20.0 (IBM Corp.; Armonk, NY, USA). The relationships between RCMs and nasal-paranasal sinus abnormalities were analyzed using the chi-squared test. Logistic regression was used to determine the risk ratio. The McNemar test was used to compare the nasal-paranasal pathology of the cyst and non-cyst sides with unilateral RCMs, OMCO, accessory ostia, and AMT. A p value <0.05 was considered to indicate statistical significance.

Results

The average patient age at the time of PNsCT was 37±13.5 (range, 16-70) years. There were 2692 (52.1%) females and 2474 (47.9%) males. RCMs were present in 18.2% of 10,332 maxillary sinuses. There were 445 OMCO, 737 accessory ostia, 843 AMT, and 952 NSD coexisting with the RCMs in the same side (Table 1). There was no abnormality other than RCMs in 895 patients.

All correlations between the presence of an RCM and nasal-paranasal sinus abnormalities were statistically significant. Of the factors examined in the multivariate analysis, the risk factors for RCMs were in the order as OMCO>accessory ostium>AMT>NSD (Table 2).

Discussion

The significance of RCMs, particularly in patients presenting to otolaryngologists with RCMs found incidentally on radiological evaluations, is controversial because it is not certain whether RCMs represent true sinus pathology or are completely incidental findings. In addition, there is no consensus regarding whether an RCM requires treatment in symptomatic or asymptomatic patients (1, 4, 7). The associated abnormalities of the nasal cavity and paranasal sinuses on CT might reveal factors predisposing to RCMs and give clinicians an idea for managing RCMs.

Figure 1. a-c. Some paranasal sinus anatomic variations accompanying maxillary sinus retention cysts; (a) middle turbinate pneumatization and nasal septum deviation; (b) an accessory ostium; (c) osteomeatal complex obstruction, middle turbinate pneumatization, and nasal septum deviation

Table 1. Distribution of nasal-paranasal sinus abnormalities by age and gender

	Age (mean±SD)	Gender, female/male	Number of abnormalities
RCMs	36.64±0.36	705/724	1880 (18.2%)
OMCO	36.84±0.50	333/389	1061 (10.3%)
Accessory ostium	36.84±0.5	1015/1076	3097 (30%)
AMT	35.01±0.26	1321/1159	3830 (37.1%)
NSD	36.60±0.25	1508/1524	6064 (58.7%)*

RCMs: Retention cysts of the maxillary sinuses; OMCO: Osteomeatal complex obstruction; AMT: Abnormalities of the middle turbinate; NSD: Nasal septal deviation; SD: Standard deviation
*NSD counted twice

Table 2. Correlation between RCMs and nasal-paranasal sinus abnormalities in the same side

Abnormalities	Coexistent with RCMs (%)	p	Logistic regression risk ratio for each variable	Logistic regression risk ratio when all variables analyzed together
OMCO	41.9	p<0.001	3.94	3.64
Accessory ostium	23.8	p<0.001	1.67	1.56
AMT	22	p<0.001	1.49	1.33
NSD	20.6	p<0.001	1.50	1.33

RCMs: Retention cysts of the maxillary sinuses; OMCO: Osteomeatal complex obstruction; AMT: Abnormalities of the middle turbinate; NSD: Nasal septum deviation

Studies have used the patient history, Lund-Mackay radiological score, and patency of the osteomeatal complex to evaluate the significance of RCMs (2, 4, 7). The correlation between RCMs and nasal-paranasal sinus abnormalities has been studied in patients with chronic sinusitis. We evaluated the PNsCT images of patients whose complaints were non-specific to investigate the relationship between incidental RCMs and the relevant nasal-paranasal sinus pathologies. Consecutive patients were enrolled to eliminate variations depending on the climate at the time of PNsCT. Comparing unilateral RCMs with the opposite side should prevent individual minor factors, such as allergic rhinitis, smoking, or heavy metal exposure, which may affect the study results.

The etiology of RCMs is not clear; barotrauma, dental disease, sinusitis, and allergic rhinitis have been considered in the formation of RCMs (4, 12). Recent studies have demonstrated that patients with RCMs had a higher Lund-Mackay radiological score for chronic rhinosinusitis than patients without cysts (2, 12). It is generally believed that OMCO, accessory ostia, AMT, and NSD can lead to complaints or symptoms via chronic paranasal sinus inflammation (13-16). Therefore, recurrent mucosal inflammation is a putative risk factor for the development of RCMs.

The treatment of chronic sinusitis is primarily directed to the pathology of the osteomeatal unit (7, 17). The relationship between RCMs and OMCO was studied in patients who had undergone PNsCT to evaluate a possible chronic sinus disease. Those studies compared only the cyst and opposite sides and concluded that RCMs are not significantly associated with OMCO (2, 4, 7). The strong association between RCMs and OMCO in our study supports that OMCO promotes the formation of RCMs. When RCMs are found incidentally, patients should be assessed for symptoms of OMCO and chronic sinusitis.

An accessory maxillary sinus ostium may be congenital or secondary to the disease processes due to obstruction of the primary ostium by maxillary sinusitis or due to pathological or anatomical reasons in the middle meatus resulting in the rupture of the membranous region known as the fontanel (18). An accessory ostium can lead to chronic mucosal inflammation of the paranasal sinuses due to circulation between the natural and accessory ostium (19, 20). It has also been suggested that antrochoanal polyps (ACPs) could arise from an antral cyst (21). In one study, 70%-100% of ACPs protruded from an accessory ostium (22). In our study, an accessory ostium seems to have a lesser role in the etiology of RCMs compared with OMCO.

Concha bullosa, paradoxical concha, bifid concha, and NSD are common anatomical variants occurring in as much as 30%-70% of the population (15, 23). The middle turbinate is important in the drainage of the maxillary sinus. Extreme NSD can obstruct the osteomeatal unit, while the role of a minimally or moderately abnormal middle turbinate and NSD in the etiology of paranasal inflammation is controversial (23, 24). These variations cause narrowing or obstruction of the osteomeatal unit, thereby reducing the normal airflow and mucociliary clearance of the sinuses. The strong relationship between unilateral AMT and RCMs suggests that we should evaluate AMT for a further risk of RCMs or maxillary sinus pathology. Although the significant relationships between the presence of RCMs and AMT or NSD are meaningful, further research is needed to ascertain the correlation, including the degrees of the pathologies and the clinical findings.

Prospective studies about RCMs, including patient complaints and endoscopic examinations, in addition to the PNsCT analyses, will provide further information on the assessment and management of RCMs.

Many predisposing factors might lead to the development of RCMs. The analysis of the relationships of RCMs and nasal-paranasal sinus abnormalities should provide information regarding the formation of the cysts and should help to determine the management of this common entity.

Conclusion

This study analyzed the coexistence of RCMs with OMCO, accessory ostia, AMT, and NSD by examining the PNsCT findings in 5166 patients. We postulate that RCMs are associated with nasal-paranasal sinus abnormalities that increase the risk

of nasal-paranasal sinus inflammation, particularly OMCO. Physicians should consider these relationships when informing patients regarding not only the possible symptoms and disease that might progress but also regarding the actual symptoms of which they might not be aware.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Health Sciences University Tepecik Training and Research Hospital (2015, 2/27).

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