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ORIGINAL ARTICLE

Antral pseudocysts of the maxillary sinus: relationship between radiographic and clinical features

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Abstract:

Antral pseudocysts of the maxillary sinus are the second most common lesions in the maxillary sinus region. The aim of this study was to analyze the frequency of antral pseudocysts of the maxillary sinus diagnosed with panoramic radiographs, cone beam computed tomography and a clinical questionnaire. This was a cross-sectional study involving patients of a private radiology institute. A total of 185 panoramic radiographs with images suggestive of antral pseudocysts were selected out of 6,000. The patients were invited to attend the service and 28 were selected for this study. Panoramic radiographs were obtained and, when the image was suggestive of antral pseudocysts, the patient was invited to undergo cone beam computed tomography and to answer a clinical questionnaire. The control group consisted of 30 patients without antral pseudocysts on panoramic radiographs who had undergone cone beam computed tomography and who had filled out the clinical questionnaire. Pearson's chi-square test and Fisher's exact test were used to determine differences in the frequency of the variables among study groups, adopting a p value of 0.05 and a 95% confidence interval. The relationship between cone beam computed tomography and the diagnosis of antral pseudocysts, and with the data collected with the clinical questionnaire was established. A statistically significant difference was found regarding atrophy of the turbinates and obstruction of the meatal ostium. In addition, patients with antral pseudocysts had significantly more histories of allergy, allergy persistence, and use of topical nasal medication compared to the control group, as well as nasal obstruction, thick nasal discharge, a runny nose and postnasal drip. The use of topical nasal medication and the presence of atrophy of the turbinates and obstruction of the meatal ostium suggest a relationship with the occurrence and persistence of antral pseudocysts.

Keywords: Radiography, Panoramic; Cone-Beam Computed Tomography; Maxillary Sinus.

INTRODUCTION

Antral pseudocysts (APCs) and mucous retention cyst of the maxillary sinus (MRCMS) are the second most common lesions in the maxillary sinus region[1-4]. They are characterized by retention of mucus from the mucous glands of the epithelial lining of the maxillary sinus and affect patients of all races, both genders and various age groups[2,5-7]. These expansive, chronic cysts radiographically appear as single or multiple radiopaque lesions of the sinus wall with dome-shaped and distinctly rounded edges[2,6,8,9]. APCs may be unilateral or bilateral and commonly emanate from the sinus floor[10,11], growing slowly for years and thus preserving the mucous membrane and cortical integrity[2,12]. Some cysts remain unchanged over time, some increase gradually and are generally asymptomatic, while others disappear spontaneously[2,11,12].

The pathogenesis of APCs is undefined[9,12,13], although it seems to be strongly related to allergic, inflammatory or infectious processes, trauma, relative humidity and room temperature[5,8-13]. Coleman *et al.*[14] detected a significant degree of sinus pathology in a group of patients living in polluted urban environments. Histopathologically, APCs are usually small and are found within the inflated sinus mucosa or as an inflammatory polyp lined with duct epithelium that can become flat, resembling simple stratified epithelium[15].

Cone beam computed tomography (CBCT) has been introduced in different areas of research and in clinical dentistry and is considered to be an important tool for the diagnosis and the planning of maxillary sinus treatment[10,16]. CBCT reproduces mineralized maxillofacial tissues as three-dimensional images with minimal distortion and with radiation doses that are significantly lower than those of computed tomography (CT)[16-18]. Despite its advantages, CT it is no longer used in routine dental care because of the high radiation doses required and cost[10,17,18]. CBCT may become an important tool for the diagnosis of changes as well as for the planning of treatment of maxillary sinus alterations[10,13]. An early diagnosis of APCs is considered essential in order to observe their behavior and evolution and thus establish and follow the necessary treatment monitoring protocols[13,19].

In view of the scarcity of studies on the possible causes of the evolution of APCs, the aim of this study was to assess their frequency and to determine their causes using panoramic radiographs, CBCT and a clinical questionnaire.

MATERIAL AND METHODS

The study was approved by the local Ethics Committee of Federal University of Goiás (Approval No. 169/2009). This cross-sectional design involved patients of a private radiology institute (Revelação Imagens Orais, Brasília, DF, Brazil), investigated between October 2006 and June 2010.

Of the 6,000 panoramic radiographs, 185 with images suggestive of APCs were selected. The inclusion criteria for the sample was patients aged more than 18 years. Based on this information, the patients were invited to attend the service. Thirty patients returned and two were excluded from the sample: one had made in the maxillary sinuses surgery and the other was pregnant. Panoramic radiographs were obtained and, when the image was suggestive of APC, the patient was invited to undergo CBCT and to answer a clinical questionnaire.

The control group randomly selected from the database of the same radiology service consisted of 30 patients without APCs on panoramic radiographs who had undergone CBCT and who had filled out the clinical questionnaire. Panoramic radiographs were obtained with the Orthoralix® 9200 AEC+ Panoramic X-ray system (Gendex Dental Systems, Des Plaines, IL, USA) using 0.5-mm focus and Kodak dental film (T-MAT, 15X30, Manaus, AM, Brazil), and were stored in digital JPEG format, at 150 dpi, using the ScanJet 4C HP® scanner with a transparency unit.

Two oral and maxillofacial radiology specialists with more than 10 years of clinical experience were calibrated and scrutinized the images for the detection of APCs. In the case of disagreement between them, a consensus was reached by discussing the image with a third oral and maxillofacial radiology specialist. The criterion for APCs detection on the panoramic radiograph was the visualization of a dome-shaped radiopaque image on the floor or on other walls of the maxillary sinus.

When APCs was detected on the panoramic radiograph, CBCT was performed for better evaluation of the maxillary sinus. The CBCT images were obtained with an iCAT scanner® (Imaging Sciences International, Hatfield, PA, USA) at 120 kVp, 18.45 mA and exposure of 20 seconds. The exposure area measured 13 cm (from the crowns of the upper teeth to the middle third of the frontal bone) and the voxel size was 0.3 x 0.3 x 0.3 mm, with a gray scale of 12 bits. The images in DICOM format were processed, analyzed and measured using the XoranCat® software (version 3.1.62; Xoran Technologies, Ann Arbor, MI, USA).

The criterion for APCs detection by CBCT was the visualization of a dome-shaped opacity on the floor or on other walls of the maxillary sinus. The maxillary sinuses were evaluated in 0.3 mm-thick axial, coronal and sagittal multiplanar reconstructions. The periapical and periodontal changes and their relationship with the floor of the maxillary sinuses were examined in 1.0 mm-thick parasagittal (transaxial) reconstructions spaced 1.0 mm apart. For illustration,

the 3D images were reconstructed in view type sinus/bone using the 3DVR software version 4.9, powered by AlloVision - Custom Visualization for the Medical Community.

The radiographs and CBCT scans were evaluated with a computer equipped with an Intel® Core™ 2 Duo-e6300 2.00 GHz, 2.93 GB of RAM (Intel Corporation, USA), NVIDIA GeForce 6200 TurboCache video card (NVIDIA® Corporation, USA) and a 19-inch EIZO monitor (FlexScan S2000.1600 x 1200 pixels; EIZO NANAO® Corporation, Hakusan, Japan), in an appropriate environment.

Patients with APC and the control group underwent anamnesis and answered a clinical questionnaire concerning date of the initial and control panoramic radiograph, history of nasal allergy, persistent nasal allergy, facial trauma prior to diagnosis, imaging examination after the initial radiograph, nasal sinus treatment after the initial radiograph, surgery on the maxillary sinus or nasal cavity, tobacco use, use of topical medication, presence of nasal obstruction, runny or thick nasal discharge, and postnasal drip. The panoramic control radiograph, CBCT and clinical questionnaire were scheduled for the same day.

During analysis of the APCs images, other findings were obtained such as the side (right or left), location (floor, ceiling or anterior wall), presence of nasal septum deviation, nasal concha hypertrophy, nasal concha atrophy, meatal ostium obstruction, rupture of the wall of the maxillary sinus, apical and periodontal lesions, and presence of other maxillary sinus pathologies.

DATA ANALYSIS

After the imaging diagnosis of APCs and the determination of the possible causes of cysts obtained with the questionnaire for the experimental and control groups, the data were analyzed statistically. The frequencies of the variables studied were compared using the Statistical Package for the Social Sciences for Windows 20.0 (SPSS, Inc., Chicago, IL, USA). Pearson's chi-square test and Fisher's exact test were used to determine differences in the frequency of the variables among study groups, adopting a p value of 0.05 and a 95% confidence interval.

RESULTS

Some CBCT findings such as septal deviation, turbinate hypertrophy, atrophy of the turbinates and obstruction of the meatal ostium (Figure 1) were detected more frequently in patients with APC than in the controls. A statistically significant difference was only observed for atrophy of the turbinates ($p = 0.022$) and obstruction of the meatal ostium ($p = 0.048$) (Figure 2; Table 1).

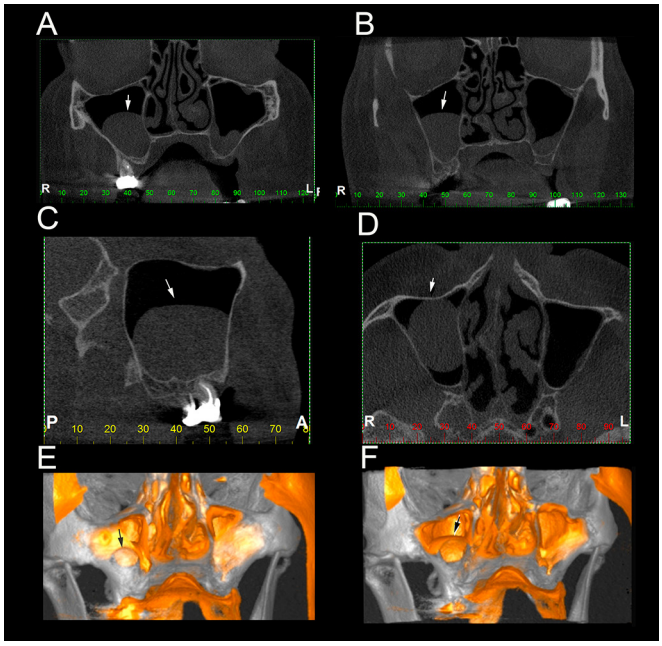

Figure 1. Presence of a antral pseudocyst in the right maxillary sinus. Dome-shaped opacification in the right maxillary sinus floor compatible with an antral pseudocyst. Note the nasal septum deviation to the right side and alterations in the morphology and size of the nasal turbinates. The middle and lower turbinates are atrophic on the right side and enlarged on the left side. The left middle turbinate is bullous. Reconstructions: coronal (A, B), sagittal (C), axial (D), and 3D (E, F).

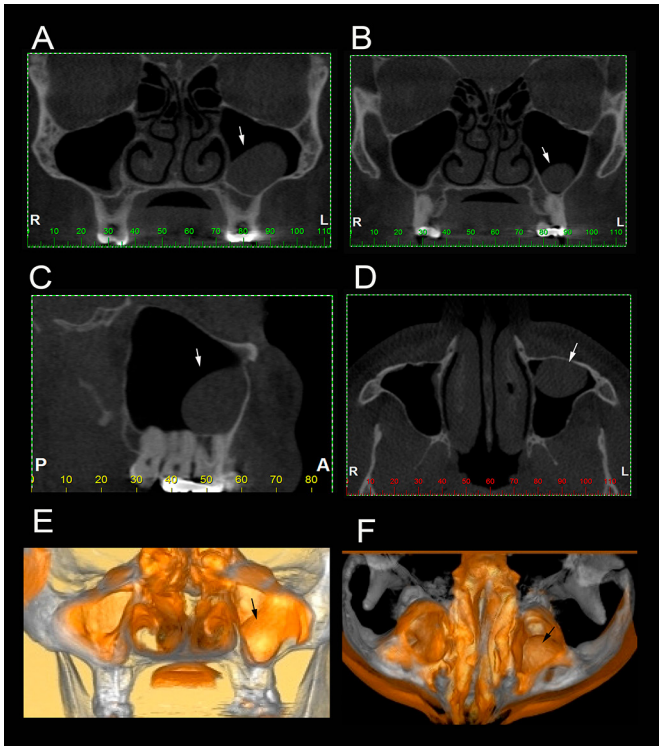

Figure 2. Presence of a antral pseudocyst in the right maxillary sinus. Dome-shaped opacification in the left maxillary sinus floor compatible with as antral pseudocyst. Note the nasal septum deviation to the left side and hypertrophy of the middle and lower nasal turbinates on both sides. Reconstructions: coronal (A, B), sagittal (C), axial (D), and in 3D: coronal (E) and axial view (F).

Table 1. Relation between some CBTC findings and diagnosis of APCs

Variables	Groups		p-value
	Experimental n (%)	Control n (%)	
Septal deviation			
Yes	18 (64.3)	13 (43.3)	0.182 *
No	10 (35.7)	17 (56.7)	
Turbinate hypertrophy			
Yes	20 (71.4)	14 (46.7)	0.100 *
No	8 (28.6)	16 (53.3)	
Turbinate atrophy			
Yes	11 (39.3)	3 (10.0)	0.022 *
No	17 (60.7)	27 (90.0)	
Obstruction of meatal ostium			
Yes	4 (14.3)	0 (0.0)	0.048 **
No	24 (85.7)	30 (100.0)	
Apical lesion			
Yes	4 (14.3)	8 (26.7)	0.402 *
No	24 (85.7)	22 (73.3)	
Periodontal lesion			
Yes	2 (7.1)	2 (6.7)	1.000 **
No	26 (92.9)	28 (93.3)	

(*) Chi-square (**) Fisher's exact test

Regarding the data obtained with the clinical questionnaire, patients diagnosed with APC had significantly more histories of allergy ($p = 0.036$), persistence of nasal allergy ($p = 0.017$), and use of topical nasal medication ($p = 0.008$) than controls (Table 2).

The frequency of some data collected during anamnesis was also significantly higher in patients with APCs. Nasal obstruction, thick nasal discharge, a runny nose and postnasal drip were more common ($p < 0.001$) in patients of the experimental group (Table 3).

DISCUSSION

The pathogenesis of APCs is still uncertain, with some studies correlating the onset of this lesion with clinical factors and others associating it with the presence of allergies[2,20]. In view of the scarcity of literature studies reporting APCs and its etiology, the application of a clinical questionnaire to patients with APCs may clarify the presence, persistence and/or disappearance of these cysts.

Rodrigues *et al.*[2] found no significant correlation between air relative humidity, average temperature and month of diagnosis of MRCMS. However, other studies[6,21-23] do not agree about a correlation between cysts and allergy, asthma, dental problems,

Table 2. Relationship between data collected during the clinical questionnaire and the diagnosis

Variables	Groups		p-value
	Experimental n (%)	Control n (%)	
Patient informed by dentist			
Yes	4 (14.3)	0 (0.0)	0.048 **
No	24 (85.7)	30 (100.0)	
History of nasal allergy			
Yes	15 (53.6)	7 (23.3)	0.036 *
No	13 (46.4)	23 (76.7)	
Persistence of nasal allergy			
Yes	15 (53.6)	6 (20.0)	0.017 *
No	13 (46.4)	24 (80.0)	
Previous trauma to diagnosis			
Yes	5 (17.9)	2 (6.7)	0.246 **
No	23 (82.1)	28 (93.3)	
X-ray exam after initial X-ray			
Yes	10 (35.7)	0 (0.0)	< 0.001 **
No	18 (64.3)	30 (100.0)	
Nasosinus treatment after initial X-ray			
Yes	6 (21.4)	10 (33.3)	0.385 **
No	22 (78.6)	20 (66.7)	
Surgery after initial X-ray			
Yes	0 (0.0)	1 (3.3)	1.000 **
No	28 (100.0)	29 (96.7)	
Smoker			
Yes	7 (25.0)	2 (6.7)	0.075 **
No	21 (75.0)	28 (93.3)	
Use of nasal medication			
Yes	11 (39.3)	2 (6.7)	0.008 *
No	17 (60.7)	28 (93.3)	

(*) Chi-square (**) Fisher's exact test

Table 3. Relationship between the frequencies of some data collected during the clinical questionnaire

Variables	Groups		p-value
	Experimental n (%)	Control n (%)	
Nasal obstruction			
Constant	7 (25.0)	0 (0.0)	< 0.001 **
Sometimes	21 (75.0)	6 (23.1)	
Rarely	0 (0.0)	20 (76.9)	
Thick nasal discharge			
Constant	3 (10.7)	0 (0.0)	< 0.001 **
Sometimes	25 (89.3)	6 (20.7)	
Rarely	0 (0.0)	23 (79.3)	
Runny nose			
Constant	4 (14.3)	1 (3.6)	< 0.001 **
Sometimes	24 (85.7)	8 (28.6)	
Rarely	0 (0.0)	19 (67.8)	
Postnasal drip			
Constant	7 (25.0)	3 (10.7)	< 0.001 *
Sometimes	21 (75.0)	10 (35.7)	
Rarely	0 (0.0)	15 (53.6)	

(*) Chi-square (**) Fisher's exact test

or blocked ostiomeatal complex. Furthermore, Meer and Altini[15] observed that some of these cysts can develop due to an invagination of the normal epithelium of the sinus in the underlying connective tissue as a consequence of ostium obstruction. In the present study, the APCs findings were correlated with local causes as determined by assessment of the maxillary sinus by CBCT, and with allergy and the use of topical medication as reported by the patients when answering the questionnaire.

During the past decade, CBCT images have gained great popularity in oral and maxillofacial diagnosis and CBCT is the most recently developed 3D radiographic modality used in dental practice[16-19,24]. The advantages of CBCT over CT are its specific design for the dentomaxillofacial region and production of good 3D images within a much shorter scanning time, at a much lower radiation dose (a 50–90% reduction compared to medical-grade CT of the head)[25]. In agreement, Rege *et al.*[1] detected maxillary sinus changes by CBCT; 68.2% of the cases had abnormalities such as mucosal thickening, MRCMS and opacification.

In the present study, we observed 185 images suggestive of APCs out of the 6,000 panoramic radiographs examined (3.08%). In a recent study, Marçal Vieira *et al.*[20] determined the frequency of MRCMS using panoramic radiographs and found 87 (6.89%) radiographs with images suggestive of MRCMS, claiming a low frequency of the findings concerning this sort of cyst. Corroborating these findings, Rodrigues *et al.*[2] estimated the prevalence and analyzed the risk factors for MRCMS. Although most APCs are asymptomatic and are detected during routine radiographic exams, they may also present eventual symptoms such as migraine, nasal congestion, dizziness, paresthesia, the presence of yellow fluid, drainage, respiratory allergy, and sensitivity to palpation[23]. The use of a questionnaire in order to obtain clinical information permits the clarification of the correlation between clinical findings and the image of the lesion.

Inflammatory lesions of the maxillary sinus must be considered in the differential diagnosis, as well as polyps and dentigerous cysts. Furthermore, a variety of neoplastic lesions may appear in this peculiar area of the face, with squamous cell carcinoma tending to be misdiagnosed with APCs and MRCMS[9,24,25]. Thus, when studying this anatomical region, it is important to emphasize the use of CBCT applied by an oral and maxillofacial radiologist for a better evaluation.

Antral pseudocysts and MRCMS are common findings in imaging studies and their prevalence is found to be up to 3.56%[11]. In 1942, Lindsay[28] described two types of maxillary sinus cysts and referred to them as nonsecreting or secreting cysts. The latter were classified as retention (glandular) cysts or mucoceles. The most common approach to patients with APCs is radiographic monitoring since most of the lesions are asymptomatic and generally require no treatment. Nevertheless, when symptoms such as headaches and periorbital pain associated with the paranasal sinuses are present, surgical treatment may be necessary.

Many patients even report different types of allergies, although it is not clear if their frequency is higher than in the overall population[2,10,20]. Sinusitis, APCs and MRCMS are the most common disorders of the maxillary sinus, with their frequency ranging from 1.4% to 10.1%[1-4]. The present results show that other pathologies can be associated with APCs and can serve as indicators of their presence. Nasal obstruction, thick nasal discharge, a runny nose and postnasal drip were more common in patients of the experimental group, with statistically significant differences, as shown in Table 3.

Among the signs and symptoms that seem to be somehow associated with the evolution and establishment of APCs are turbinate changes and obstruction of the meatal ostium. The turbinates are the structures responsible for directing the air into the pathways to the lungs, humidifying and filtering it. The lateral part of the nasal cavity is subdivided by the turbinates into four meatuses. The middle meatus is the space lateral to the middle turbinate and is often functionally referred to as the ostiomeatal complex[29].

It contains the drainage pathways for the anterior ethmoids and the maxillary and frontal sinuses. The middle meatus is the area most commonly involved in the pathophysiology of chronic alterations of the maxillary sinus, causing nasal obstruction, a runny nose and postnasal drip[29]. These symptoms were analyzed in this study and were found to be present in the experimental group, with a statistically significant difference between the data collected during anamnesis and during the diagnostic process of APCs. Considering the presence of these symptoms, such as obstructions, it is to be expected that patients with APCs will use nasal medication more frequently.

The analysis performed in this study showed that nasal allergy seems to be related to the presence

of APCs, mainly because these cysts may reflect nasal obstruction especially when associated with septal deviation which narrows the airway, making it even more difficult to breathe, forcing mouth breathing and favoring allergies as well as dental cavities. There also seems to be a relationship between the persistence of nasal allergy and the presence of APCs. The former leads to the use of nasal medications, regardless of their chemical composition.

Moon *et al.*[30] evaluated the characteristics of mucous cysts in paranasal sinuses by brain magnetic resonance imaging and elaborated a medical questionnaire. Of the subjects studied by them, 50.1% were smokers. The authors concluded that smoking increases the risk of mucous cysts in paranasal sinuses. However, in the present study it was not possible to relate the smoking habit to the presence of APCs since only two subjects were smokers.

CONCLUSION

In summary, it was observed a low prevalence of APCs and is in agreement with the literature. The use of topical nasal medication and the presence of atrophy of the turbinates and obstruction of the meatal ostium suggest a relationship with the onset and persistence of APCs. However, further studies are needed to consolidate the etiology of APCs.

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