Pseudocysts and retention cysts of the maxillary sinus

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The dome-shaped radiopaque shadows frequently seen on the floor of the maxillary sinus, and sometimes inaccurately referred to as antral mucoceles, appear to represent focal accumulation of inflammatory exudate that lifts the epithelial lining of the sinus and the periosteum away from the underlying bone to form the characteristically shaped structures. Their histologic appearance is therefore that of normal or inflamed maxillary sinus lining. There is no epithelium-lined cavity present beneath the sinus mucosa; consequently, the term pseudocyst of the maxillary sinus is advocated. Less commonly, epithelium-lined retention cysts, similar to those of the minor salivary glands, are found, but mucoceles of the type found in the oral cavity apparently do not occur in the maxillary sinus.

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Fig. 1. Four views of pseudocysts of the maxillary sinus illustrated by different types of radiograph. 

A, Periapical film illustrating the typical dome-shaped lesion in the floor of the sinus. Vascular channels in the wall of the sinus may be seen through the pseudocyst. B, Part of a Panorex film showing a pseudocyst in the maxillary sinus. C, Tomograph showing pseudocysts in both maxillary sinuses. These lesions burst, releasing a clear fluid, when a surgeon performed an exploratory Caldwell-Luc operation. Their histologic appearance is illustrated in Figs. 2, A and 3. D, CAT scan of the same patient as in Fig. 1, C. Only one of the two pseudocysts was apparent at this particular level.

include mesothelial cyst,6 interstitial cyst,7 and lymphangiectatic cyst.8 Paparella8 refers to them as benign mucosal cysts of the antrum, or simply as mucosal cysts, while Zizmor and Noyek9 call them serous cysts.

The secretory (retention) cyst represents dilatation of the duct of a seromucinous gland and is therefore lined with epithelium. Zizmor and Noyek9 refer to this lesion as a mucous cyst. The variety of names used for these lesions is confusing and is complicated by the fact that no clear trend as to the most acceptable terminology has emerged in otolaryngologic practice. The terms secreting cysts and nonsecreting cysts appear to be of historical interest only and their use should therefore be discouraged. The following classification appears to be appropriate and will be used in this article.

Cysts and cystlike processes arising from the sinus mucosa
1. Pseudocysts
2. Retention cysts
3. Mucoceles

While it may be argued that the term cyst does not necessarily require that the lesion be lined with epithelium, I have referred to those lesions that lack such a lining as pseudocysts, a term that is used currently and that is more specific than Paparella’s mucosal cyst.8

PSEUDOCYSTS

The clinical and radiologic features of these lesions are well known and have been reviewed recently by Allard and co-workers.10

At gross examination, the lesion is characterized
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Fig. 2. Pseudocysts of the maxillary sinus. Two examples of the histologic appearance of the walls of these lesions. In both cases the lumen (Im) of the pseudocyst is at the bottom of the photomicrograph. The appearance is identical to that of the lining of the maxillary sinus and, in fact, probably represents that lining displaced by fluid. Consequently, it is not possible to make the histopathologic diagnosis of pseudocyst without knowledge of the radiologic and/or clinical features. A, Part of the wall of one of the pseudocysts illustrated in Fig. 1, C and D. B, The condensation of connective tissue at the base of this example is more pronounced than that in A but is quite typical. (Hematoxylin and eosin stain. Original magnifications, ×80.)

by a very thin membrane. Microscopically, it is covered with pseudostratified columnar ciliated epithelium with goblet cells resting on a superficial layer of loose connective tissue that is sometimes edematous and may exhibit chronic inflammation of variable intensity (Fig. 2). Beneath the loose connective tissue, and lining the lumen of the pseudocyst, is a denser, compact layer of fibrous connective tissue which lines the lumen of the pseudocyst and which appears to be periosteum; sometimes a layer of slender fibroblasts is present immediately adjacent to the lumen. In some cases foci of cholesterol crystal slits with associated multinucleated giant cells and sometimes calcifications (Fig. 3, A and B), hemosiderin, and chronic inflammation are present. No ducts or seromucinous glands or mucinicarmophilic material are present within the connective tissue.

On occasion, the connective tissue of the lesion is denser than just described and exhibits an amorphous, eosinophilic appearance which was concluded by Kwapis and Whitten to be mucin. However, it stains positively with van Gieson’s stain for collagen and does not stain with mucicarmine; moreover, the absence of glands or ducts is significant.

The histologic appearance of the wall of these pseudocysts is that of normal or inflamed antral lining; consequently, it would not be possible to make the diagnosis of pseudocyst without an appropriate clinical history of the presence of such a lesion. This histologic appearance suggests that the pseudocyst is formed by the accumulation of fluid beneath the periosteum, lifting it off the bone and the floor of the sinus to form the characteristic dome-shaped structure.

Lindsay has studied the fluids of these pseudocysts extensively. On the basis of their high specific gravity, high protein concentration, and ability to coagulate, he concluded that they were inflammatory exudates. He found that the pattern of electrolytes did not resemble a transudate, that is, an ultrafiltrate
Fig. 3. A, Part of the lining of one of the pseudocysts illustrated in Fig. 1. C and D. Cholesterol crystal slits and associated giant cells are present at the bottom of the photomicrograph. The small spherical structures in the top part of the photomicrograph are calcifications, as is shown by their staining positively with von Kossa's silver method for calcium (B). (A, Hematoxylin and eosin stain; B von Kossa's stain. Original magnifications. A, ×200; B, ×80.)
of serum. Lindsay further concluded that these cysts are not caused by an allergic reaction, because the edema associated with allergy is a transudate. He believed that the probable explanation for the formation of these cysts is that bacterial toxins in an infection increase the capillary permeability, thus allowing fluid to accumulate in the tissues. Apparently, the fluids are not drained by the lymphatics, but no explanation has been offered for this phenomenon.

Mills does not agree that the fluid is an inflammatory infiltrate but postulates that it is possible for a retention cyst in a mucous gland to rupture and then continue to secrete into the surrounding tissue, thus forming a cavity filled with mucus. If this were so, the histopathologic appearance of such a pseudocyst would be similar to that of the mucocele of the oral cavity. While Kwapis and Whitten claim that there is a remarkable similarity between the two lesions, this is not the case. No mucin can be demonstrated in the tissues, no histiocytes are present, and, as Kwapis and Whitten point out, there are no associated mucous glands or their ducts present. Moreover, the cysts are not lined with the condensed granulation tissue seen in oral mucoceles. Finally, mucus secretions do not coagulate as do the fluids of the pseudocysts. A lesion similar to the oral mucocele apparently either does not occur in the antral mucosa or is very rare.

The pathogenesis of polyps of the sinonasal tract is probably similar, but not identical, to that of the pseudocysts. Both lesions appear to be caused by the accumulation of inflammatory exudate in the tissues. The basic difference between the pseudocysts and the polyps is that in the former the fluid apparently accumulates beneath the periosteum, forcing the antral lining away from the bone to form the typical dome-shaped structure, while in polyps the fluid accumulates in the loose connective tissue of the lamina propria of the lining of the sinonasal tract.

This difference in pathogenesis is reflected in certain clinical differences between the two lesions. The sinus mucosa adjacent to polyps is generally thickened by edema; this is not true in the case of the pseudocysts. Pseudocysts are typically dome-shaped, while polyps are often pendulous or irregularly shaped. In this connection, gravity plays a part in the typical pendulous appearance of the polyps as the weight of the fluid causes them to hang from the sinus wall or roof or, on occasion, through an oral-antral fistula. Polyps of the floor of a sinus, as would be expected, are sessile rather than pendulous. While delicate, polyps do contain somewhat more fibrous connective tissue than pseudocysts and there-
fore have more structure; in fact, they can become fibrotic. It is often possible to remove a polyp intact at surgery, but it is impossible in the case of pseudocysts, which burst readily, releasing their contents of straw-colored fluid. One inconstant clinical sign of these pseudocysts is the sudden spontaneous gushing of such fluid from the patient's nose after a minor traumatic experience, such as sneezing. Finally, polyps are often multiple while pseudocysts are usually solitary, although they can be bilateral.

Fluid-filled spaces occur both in the edematous lining of the maxillary sinus and in antral polyps (Fig. 4). Undoubtedly, these spaces can coalesce to form larger, fluid-filled cavities, and this mechanism has been suggested as a way in which these pseudocysts of the antrum form. However, this mechanism would result in a polyp with a relatively large cystic space; otherwise, it would have all the clinical and histologic features of an antral polyp and would not have the predilection for the floor of the sinus so characteristic of the pseudocyst.

The source of exudate in an edematous lining of the maxillary sinus, or in a polyp, is readily explained. It would occur in any infection of the sinus or in an allergic sinusitis. However, the occurrence of an exudate beneath the periosteum, as is found in the pseudocysts, requires further explanation; it is unlikely that the fluid penetrates the fibrous barrier of the periosteum. One distinct possibility is that the exudate could be associated with periapical infection of the adjacent maxillary teeth, or with periodontitis. In this connection, Halstead found that 90% of the patients in his study exhibited a possible source of periapical osteitis that could account for the existence of the dome-shaped shadows that he referred to as mucosal cysts. He concluded that periapical and periodontal diseases probably play a significant role in the origin of both maxillary sinusitis and mucosal cysts of the maxillary sinus. Halstead's was a radiologic study, and the lesions he observed could have included examples of both pseudocysts and mucous retention cysts, as defined in this article. Nevertheless, Halstead's figures support odontogenic infections as a major source of the exudate found in

**Fig. 5.** Maxillary sinus polyp exhibiting two mucous retention cysts (a and b). Retention cyst b was contained entirely within the polyp but is only partially present in this section. B, Higher magnification of part of the polyp illustrated in A. Part of the two mucous retention cysts (a and b) are illustrated, as well as seromucinous glands and their dilated ducts from which these retention cysts apparently originate. C, Part of the lining of mucous retention cyst a. The lining is pseudostratified columnar epithelium exhibiting the occasional mucous cell. (Hematoxylin and eosin stain. Magnifications: A, ×10; B, ×26; C, ×102.)
pseudocysts of the maxillary sinus. Another possible explanation involves the classic triple response of Lewis that occurs in inflammation. The second feature of this response, the flare, is attributed to a neurogenic reflex that inhibits vasoconstriction. In the case of pseudocysts of the antrum, irritation to the sinus mucosa, caused for example by infection, could result in vasodilation of the subperiosteal vessels via this reflex mechanism (the flare). In turn, subperiosteal edema would result (the wheal). The fact that these pseudocysts do not drain quickly suggests that the lymphatic drainage of the area is poor or may be impaired.

**RETENTION CYSTS**

Partial blockage, possibly by a plug of inspissated mucus, of the duct of a seromucinous gland of the sinus can result in dilatation of the duct into a cystic structure which could consequently be lined with epithelium. This is the accepted pathogenesis of some retention cysts of the sinus and is identical to that of retention cysts of the minor salivary glands of the oral cavity. In that case, however, the blockage can be caused by sialoliths as well as by mucus plugs. It must be emphasized that these retention cysts of the oral cavity are not the same as the much more common mucocele of that region. This latter entity is caused by extravasation of mucus into the surrounding tissues after damage to the main duct of the gland. A comparable lesion does not appear to occur in the maxillary sinus, despite reports to the contrary. Emphasis should be placed on the partial blockage of the ducts in the pathogenesis of retention cysts, because complete blockage would result in atrophy of the associated glands.

Seromucinous glands are normally found around the ostium of the maxillary sinus, and retention cysts could therefore occur in that region. However, these glands proliferate markedly throughout the sinus lining in prolonged infection and are often found in antral polyps. As a result, they can give rise to retention cysts away from the ostium. Most such retention cysts are small and either are not evident clinically or are seen occasionally as small cysts containing fluid or thick caseous material within inflamed mucosa removed during a Caldwell-Luc procedure for chronic sinusitis. They are often found on histologic examination of antral polyps (Fig. 5) and inflamed sinus mucosa. Occasionally they can become large enough to be evident radiologically, in which case they have the same appearance as pseudocysts if they occur on the antral floor. Consequently, the absolute incidence of neither pseudocysts nor retention cysts can be determined radiologically, although it seems reasonable that retention cysts are less common than pseudocysts, as is claimed.

Some retention cysts probably arise from invaginations of the respiratory epithelium into the underlying connective tissue. This explanation accounts for those retention cysts occurring in a normal sinus lining exhibiting no seromucinous glands.

**REFERENCES**
