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Fronto-ethmoidal mucocele - Observation of its mode of enlargement

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SUMMARY

From a study of the roentgenographic findings of fronto-ethmoidal mucoceles and anatomical specimens of the paranasal sinuses the authors surmised that many of the fronto-ethmoidal mucocele probably originate either in one of the deeply seated supra-orbital frontal or ethmoidal recesses, or in an ethmoid cell whose ostium has been obstructed by postoperative, post-traumatic or post-inflammatory osteoneogenesis or cicatrization.

When isolated, the cell with secreting mucosa would increase its cavity slowly but steadily, and eventually blocks the naso-frontal duct from without.

The characteristic localization of the mucoceles, frequent erosion of the superomedial wall of the orbit with inferolateral displacement of the globe, our roentgenographic findings of a mucocele within the frontal sinus, pseudostratified columnar epithelium that lines the mucocele, occasional multilocularity, and the long interval, over ten years, that is required for the mucocele to show any symptoms in most instances would support this hypothesis.

It has been over 30 years since the term mucocele was introduced by Rollet (1896), during which many significant contributions have been made toward a better understanding of the disease. The mucocele is a unique disease of the paranasal sinuses, that destroys the surrounding bony structure in spite of its benign nature. The etiology of the disease has been of great interest particularly as to whether it is of primary or secondary in origin.

From a study of the roentgenographic findings of eight cases of fronto-ethmoidal mucocele and a comparison of these findings with the anatomical findings of the paranasal sinuses the authors propose their view on the etiology of the disease.

METHOD

The roentgenographical characteristics of eight cases of fronto-etihmoidal mucocele which were seen during the past five years at St. Luke's International Hospi-

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tal and Tokyo Kosei Nenkin Hospital were studied.

All the patient except patient 3 were operated on, intranasally for exposure of the mucocele. They were followed up for periods from six months to five years (average two years and eight months) but there were no recurrences. No drainage tube was used in the nasofrontal duct postoperatively.

RESULTS

Case histories

Patient 1. A 66-year-old woman who had had bilateral pansinusectomy 16 years ago presented with a hard swelling at the left supra-orbital area with proptosis, diplopia and tearing. Roentgenograms (Figure 1) demonstrated a large bilocular mucocele, the medial one extending into the contralateral frontal sinus. Erosion of the superomedial wall of the orbit, marginal sclerosis and absence of scalloping were conspicuous. Intranasal ethmoidectomy by removal of the bony hard inferior wall of the mucocele produced about 10 ml of pus and left a large cavity whose posterior wall which was the dura mater per se had been pulsating.

Patient 2. A 60-year-old woman without a history of previous sinus surgery presented with a dull pain in the forehead. A large mucocele of the left frontal sinus with a fluid level was demonstrated by roentgenograms (Figure 2). Absence of scalloping, erosions of the superomedial wall of the orbit and the posterior wall of the frontal sinus, and extension of the mucocele into the contralateral frontal sinus were also confirmed. One year prior to her visit with us, the patient sustained a facial trauma, when she bumped into a corner of furniture, which was initially thought to be the cause of the mucocele.

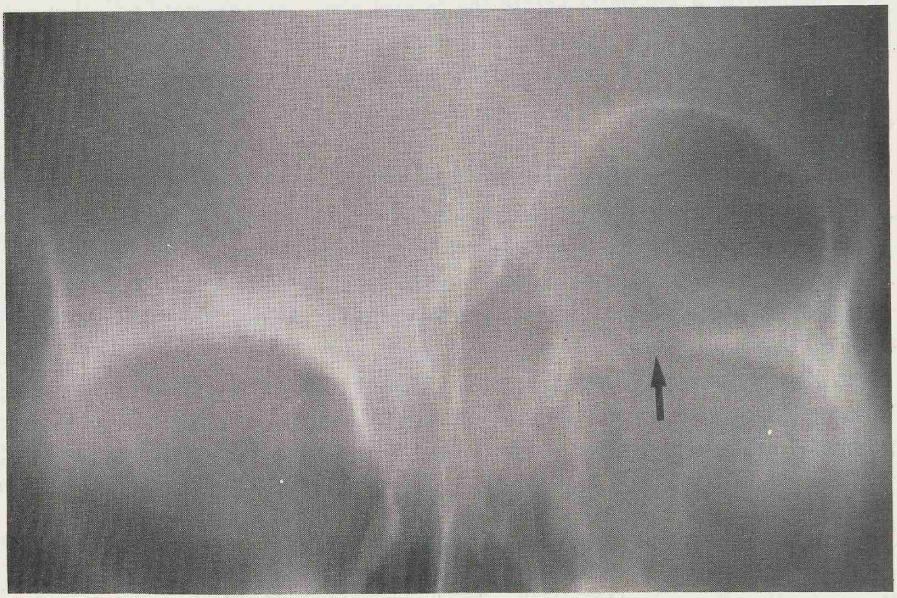

Figure 1. Radiograph of patient 1 demonstrated a large, round, bilocular fronto-ethmoidal mucocele characterized by the absence of scalloping, a marginal sclerotic line and erosions of the superomedial wall of the orbit.

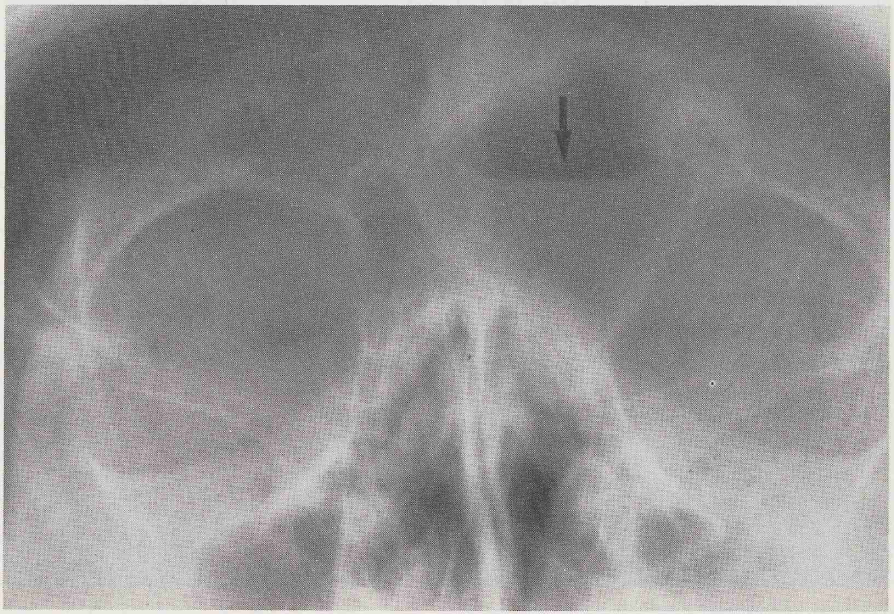

Figure 2. Radiograph of patient 2 demonstrating a large fronto-ethmoidal mucocele with a fluid level, loss of scalloping and the absorption of the superomedial wall of the orbit. The fluid level was considered to be an artifact.

However, we were aware that the patient had had a mucocele already at the time of the injury judging from the size of the mucocele and the extensive erosion with loss of scalloping, all of which seemed very unlikely to have been completed within one year. Furthermore, she had experienced frequent dull pains in the forehead even before the time of the trauma. The fluid level within the mucocele was presumed to have been caused during the trauma by a tear of the walls of the mucocele allowing partial leakage of its contents.

Patient 3. A 41-year-old woman with a history of pansinusectomy for chronic sinusitis at the age of 16 manifested a small swelling at the right inner canthus, which stayed for two years without further enlargement. Roentgenograms (Figure 3) showed a mucocele occupying the lower half of the frontal sinus and part of ethmoidal sinus.
The walls of the mucocele could be seen in a lateral view associated with erosions of the posterior table of the sinus. This roentgenogram was presumed to demonstrate the process of enlargement of a mucocele in the frontal sinus. It appeared to have developed from the area bordering the frontal and ethmoidal sinuses and enlarged into the frontal sinus in the fashion of an inflating ballon. This patient has not been operated on yet.

Patient 4. This 33-year-old woman who had had left maxillary sinusectomy at the age of 14 developed visual disturbance about six months prior to the visit, which aggravated acutely during the one week preceding to her visit to the hospital. Her vision was 0.01 on the left and 1.0 on the right. A large mucocele involving the left frontal and ethmoidal sinuses accompanied by absorption of the superomedial wall of the orbit was confirmed by radiographs. The mucocele was decompressed by the removal of its inferior wall by means of

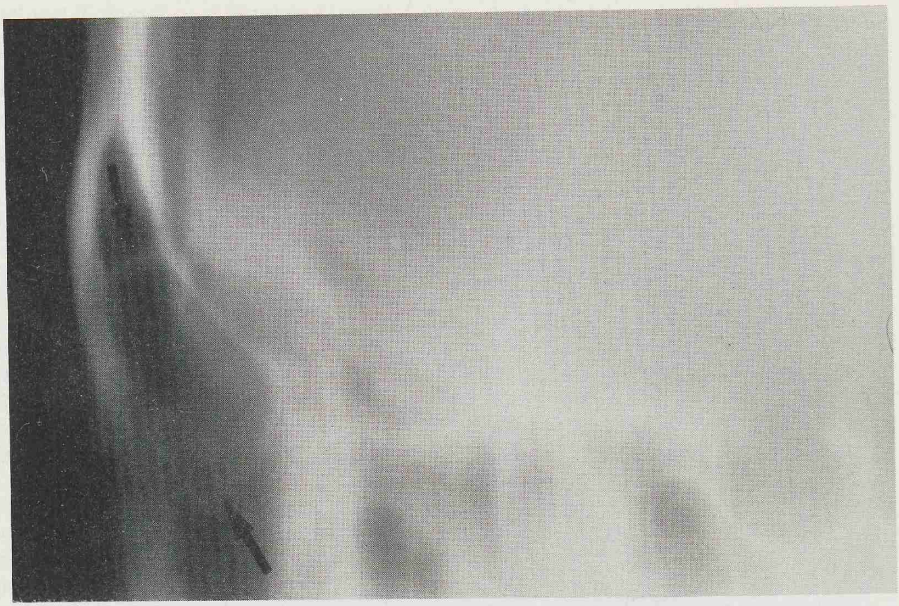

Figure 3. Radiograph of patient 3 demonstrating a mucocele in the process of enlargement within the frontal sinus with its capsule eroding the posterior wall of the frontal sinus.

intranasal ethmoidectomy which produced about 10 ml of thick brownish fluid. Postoperatively, the papilledema disappeared and her vision improved to 1.0.

Patient 5. A 41-year-old woman without a history of previous sinus surgery or trauma was referred from an ophthalmologist for a swelling at the inner canthal area of the right eye. Radiographic findings demonstrated an ethmoidal cyst with a sclerotic curved lines of thin bony wall surrounding the mucocele and erosion of the lamina papyracea. Intranasal ethmoidectomy produced about 5 ml of thick dark fluid and revealed a round cavity lined by whitish smooth mucosa.

Patient 6. A 61-year-old man presented with a painful swelling at the left supra-orbital region. Palpation indicated a bone defect underneath the swelling. A round mucocele of the left fronto-ethmoidal sinuses causing erosions of the superomedial wall of the left orbit was ascertained by roentgenograms.

Patient 7. A 30-year-old woman presented with a bulge at the inner canthal area of the right eye, right proptosis and lateral displacement of the globe resulting in a widening and flattening of the inter-orbital area. She had been operated on for the paranasal sinuses at age 20. Roentgenographic findings were those of a fronto-ethmoidal mucocele with erosions of the orbital wall. Intranasal ethmoidectomy by removal of a hard plate of bone obliterating the middle nasal meatus produced about 5 ml of pus from the ballooned ethmoidal cavity connected with the supra-orbital recesses. A postoperative contrast study showed a mucocele around the medial aspect of the globe which had restored its normal position due to decompression of the mucocele (Figure 4).

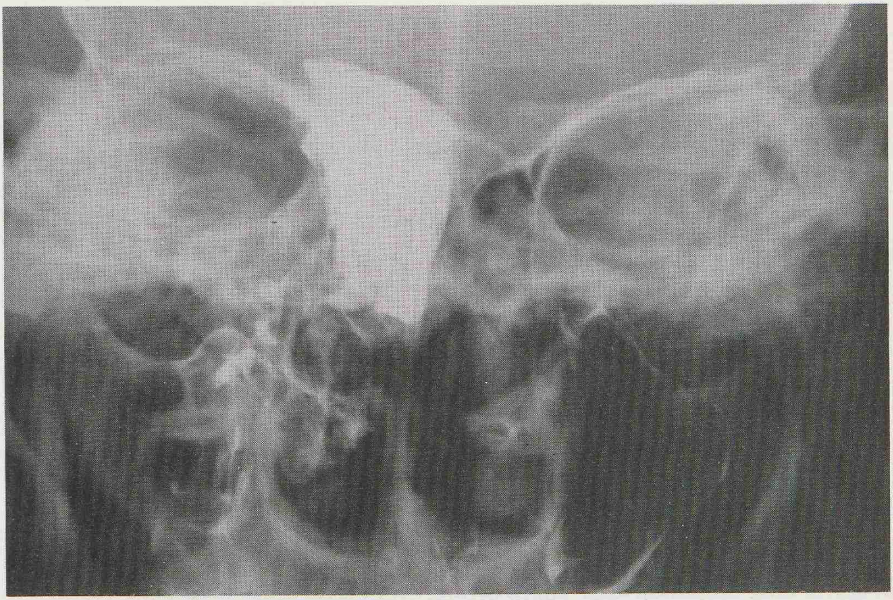

Figure 4. Radiograph of patient 7, a contrast study of a mucocele after the evacuation of its contents. The laterally displaced globe regains its normal position after the decompression of the mucocele.

Patient 8. A 56-year-old woman had been suffering from occasional diplopia noted an elastic swelling at the superomedial aspect of the left orbit. A round mucocele of the fronto-ethmoidal type was shown in the radiograms together with bone erosions around its capsule. Intranasal exposure of the mucocele evacuated about 10 ml of thick chocolate-like contents leaving a large cavity including the area of supra-orbital recesses.

DISCUSSION

Mucocele of the paranasal sinuses is not a common disease. Its most common situation is around the bordering area of the frontal and ethmoidal sinuses. Zizmor (1968) reported that of 100 patients with a mucocele of the paranasal sinuses 64 were in the frontal sinus and 30 were in the ethmoidal labyrinth. A similar result was described by Natvig (1978) who reported that of 112 cases of mucoceles, 108 cases were in the frontal and/or anterior ethmoidal sinus. Another review of 44 cases with mucoceles of the fronto-ethmoidal area in Japan by Kowata (1979) indicated that in 31 cases both frontal and ethmoidal sinuses, while in 4 the frontal sinus and in 7 the ethmoidal sinus were involved.

These reports suggest that there may be some anatomical or structural characteristics in the area bordering the frontal and ethmoidal sinuses, which predispose to the formation of mucoceles. Various theories on the development of the mucocele were summarized by Tamari in 1949. Of these theories the cardinal question

lies in whether obstruction of the ostium precede the accumulation of the contents within the sinus (secondary theory) or the mucocele develops within the sinus causing obstruction of the nasofrontal duct later on (primary theory).

A study of the radiographic findings of the present series indicated that

1. the supra-orbital frontal or ethmoidal recesses were included in all the cases presented here with the exception of patient 5;
2. erosion of the superomedial wall of the orbit was found in all cases;
3. all the mucoceles were round or oval in shape implying that the mucocele expands almost evenly in all directions;
4. patient 2 demonstrated the process of a balloon-like enlargement of a mucocele in the frontal sinus;
5. contrary to our initial notion that obstruction of the nasofrontal duct preceded the retention of fluid in the sinus in patient 3, the fluid level was found to be caused by damages to the walls of the mucocele during her facial trauma allowing partial leakage of its contents to be replaced by air.

Wigh (1950) described that supra-orbital frontal or ethmoidal cells might be the origin of a fronto-ethmoidal mucocele.

Our roentgenographical findings also indicated that the fronto-ethmoidal mucocele would most likely to originate in a deep seated cell or cells of the supra-orbital frontal or ethmoidal recesses whose ostium has been blocked by post-operative, post-traumic or post-inflammatory osteoneogenesis or cicatrization. The isolated cell with inflamed sinus mucosa maintain their function of secreting mucus into the cavity and would enlarge very slowly surrounded by reactive proliferation of the surrounding fibrous tissue till the bulging wall totally obstructs the nasofrontal duct from without. Therefore the process of enlargement of a mucocele would be the essential outcome of the constant secretion of mucus-producing cells and the connective tissue proliferation around it to resist the intramural pressure.

The supra-orbital recess, whether frontal or ethmoidal in origin, often has complicated anatomical characteristics. Deep cells with narrow ostium were found not infrequently in our specimens (Figure 5). The ostium of small cells of the ethmoidal sinus may be similarly obstructed after local injury forming a mucocele and eventually causing obstruction of the main duct of the frontal sinus (Figure 6). On the other hand, it seems unlikely that the obstruction of the nasofrontal duct precedes the retention of the fluid within the frontal sinus. Some of the reasons are: the main duct of the frontal sinus with a lining of ciliated mucosa would probably not be obstructed easily either with soft tissue or bone because of the constant flow of mucus through the duct and, as demonstrated by Schenk (1974), even mechanical obstruction of the nasofrontal duct failed to produce a frontal mucocele in dogs. It should also be pointed out that the long interval, usually over

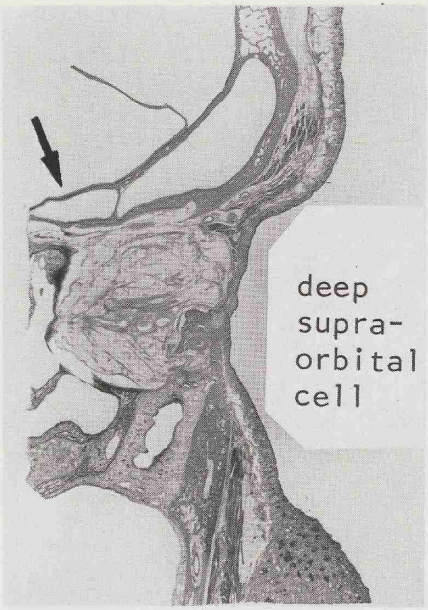

Figure 5. A sagittal section of the paranasal sinuses showing a deep supra-orbital recess (arrow).

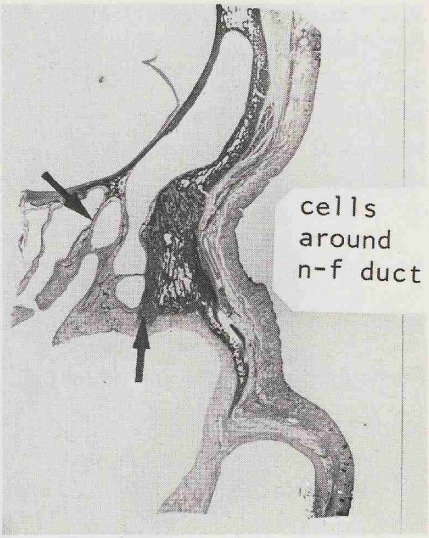

Figure 6. A sagittal section of the paranasal sinuses showing a small cell (arrow) adjacent to the nasofrontal duct and cancellous bone (arrow) anteriorly to the duct.

ten years, that is often required for the mucocele to show any symptoms after sinus surgery could not be adequately explained if obstruction of the nasofrontal duct or middle nasal meatus was the prime cause for the development of mucoceles because the postoperative tissue reaction would be completed in much less time.

The authors surmised that the etiology of the fronto-ethmoidal mucocele would lie in isolated deeply seated supra-orbital frontal or ethmoidal recesses or cells in the ethmoidal sinus such as that shown in Figures 5 and 6.
The following findings would also help to support the hypothesis:

1. the lining of the mucocele is usually pseudostratified columnar epithelium (Figure 7) as in a specimen from patient 5;
2. mucocele can be multilocular in some cases.

The mucocele has often been said to erode the thinnest bony wall with least resistance. However, the mucocele is almost always seen to enlarge in an oval or round shape and enlarges equally in all directions eroding the bony walls whether it may be thin or thick as demonstrated in our radiograms and others.
Furthermore, it has never being seen to enter the soft structure e.g. the brain or orbit to form a dumbbell-shaped mucocele. The authors' deduction on the etiology of the mucocele of the fronto-ethmoidal type has been based on the aforemen-

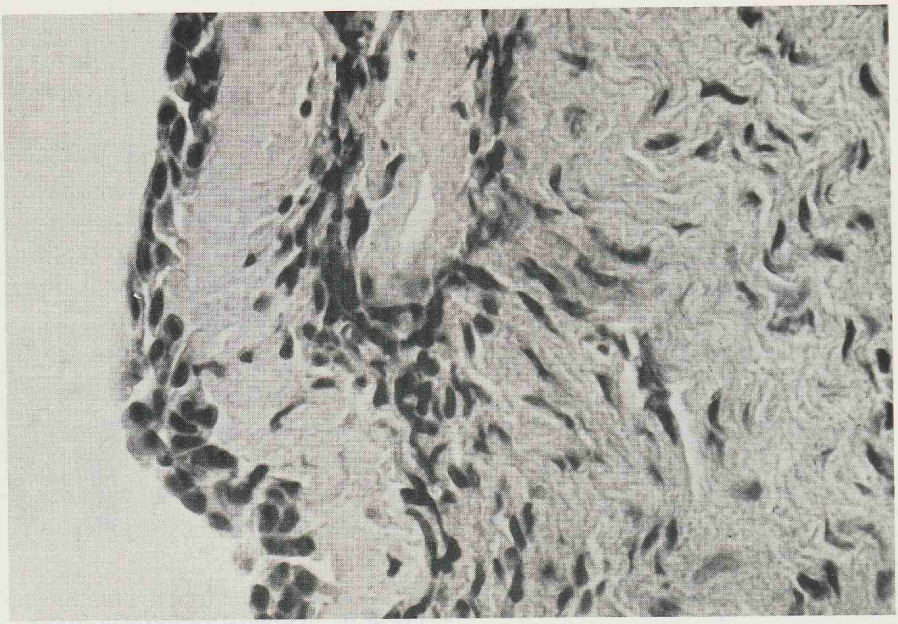

Figure 7. Histopathological picture of the wall of mucocele in patient 5 showing loss of cilia, thinning of the pseudostratified columnar epithelium and thickening of the basal membrane.

tioned findings and particularly the findings indicated in the radiograms of patient 3, where a mucocele was seen to occupy only the inferior part of the frontal sinus with its capsule causing partial erosion of the posterior wall of the sinus. We assumed that this demonstrates the actual process and the mode of enlargement of a mucocele within the sinus. The mucocele will manifest its symptoms only when the sinus walls are eroded to cause a bulge of the skin or displacement of the globe.

RÉSUMÉ

Se basant sur une étude de résultats roentgenographiques de mucocèles fronto-ethmoïdales et de spécimens anatomiques des sinus paranasaux, les auteurs ont présumé que de nombreuses mucocèles fronto-ethmoïdales prennent probablement naissance dans une cellule des replis supra-orbitaux frontaux ou ethmoïdaux profondément situés ou une cellule ethmödale, dont l'ostium a été obstrué par une ostéonéogénèse ou une cicatrisation post-opératoire, post-traumatique ou post-inflammatoire.

Isolée, la cellule avec sa muqueuse sécrétante étendrait sa cavité lentement mais incessamment, pour bloquer finalement le canal naso-frontal de l'extérieur.

Cette hypothèse serait supportée par la localisation caractéristique, par une érosion fréquente de la paroi supermédiale de l'orbite avec un déplacement inférolatéral du globe, par nos résultats roentgenographiques d'une mucocèle située dans le sinus frontal, par un épithélium cylindrique pseudostratifié marquant la mucocèle, par le fait que la mucocèle est parfois multiloculaire et par le long intervalle - de plus de dix ans - qui doit s'écouler dans la plupart des cas, avant que la mucocèle ne se manifeste.

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