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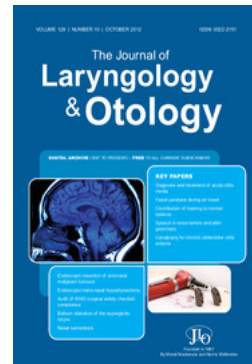
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Glyn Lloyd, Valerie J. Lund, Lloyd Savy and David Howard

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Radiology in Focus

Optimum imaging for mucoceles

GLYN LLOYD, D.M., F.R.C.R., F.R.C.OPHTH., VALERIE J. LUND, M.S., F.R.C.S., F.R.C.S.(ED.), LLOYD SAVY B.Sc., F.R.C.R., DAVID HOWARD, F.R.C.S., F.R.C.S.(ED.)

Abstract

A mucocele is an epithelial lined mucus-containing sac completely filling a paranasal sinus and capable of expansion. They are relatively unusual, occurring most frequently in the fronto-ethmoidal region. The imaging features on plain X-ray, computerized tomography and magnetic resonance imaging are relatively characteristic allowing distinction of the lesion from other pathologies in this area although the mucoceles may occur in association with other pathologies such as nasal polyposis and neoplasia.

Key words: Mucocele; Frontal sinus; Ethmoid sinus; Diagnostic imaging

Introduction

A mucocele is an epithelial lined mucus-containing sac completely filling a paranasal sinus and capable of expansion by virtue of a dynamic process of bone resorption and new bone formation.^{1,2} They are locally destructive and the erosion and expansion of the bony walls encroach upon and displace adjacent structures. They occur most frequently in the frontal sinus but may arise in the ethmoids and rarely in the sphenoid sinus or maxillary antrum (Table I). They may result from infection, trauma including previous surgery, fractures and bullet wounds, nasal polyposis, or tumours (benign e.g. osteomas) or rarely, malignant). Most cases result from a combination of obstruction and inflammation although cases in which no demonstrable cause can be determined, represent the largest sub-group (36 per cent).³ In some cases there is histological evidence of an increase in the number of secretory cells in the lining membrane and hypersecretion of mucus may be a contributory factor.^{2,4} One recent study has demonstrated an increase in pressure within the mucocele.⁵

Materials and methods

From a cohort of 121 patients with paranasal sinus mucoceles, imaging was available for retrospective study in 70 cases. This review is based upon the results of this analysis together with the review of the relevant literature.

TABLE I
DISTRIBUTION OF PARANASAL SITE MUCOCELES
(n = 121)

Fronto-ethmoid	89%
Ethmoid	8%
Sphenoid	2%
Maxilla	1%

Plain X-rays

Frontal sinus mucoceles can be readily diagnosed on plain X-ray but mucoceles in the maxillary antrum and sphenoid sinuses may not be recognized as such and in the anterior ethmoids they may be missed entirely. For these reasons CT is the primary imaging method of choice.

Computerized tomography (CT)

CT in the axial and direct coronal planes is the optimum method of showing the bone expansion which occurs in mucocele formation; typically the bony outline becomes more rounded as the bone remodels in response to the growing pressure within the sinus cavity. The mucocele content is demonstrated as an homogeneous substance of mucoid attenuation (10 to 18 HU).⁶ In long-standing mucoceles with a high protein content, the attenuation is higher (20–40 HU). After intravenous contrast, only the lining membrane of the mucocele will enhance, though the administration of contrast medium is rarely necessary. Contrast enhancement is best reserved for magnetic resonance imaging (MRI) particularly when there is mucocele formation secondary to a sinonasal tumour (*Vide infra*).

Magnetic resonance imaging

Most mucoceles, especially the most common occurring in the frontal sinus, can be diagnosed by CT or plain X-ray. MRI is only indicated when there is uncertainty following the use of these techniques. The usual signal characteristics are a low T₁ and a high T₂ but any combination of signal intensity may be seen depending on the presence of blood products or the degree of hydration of the contents. Generally the older the mucocele the shorter the T₁ relaxation time. In these circumstances gadolinium-enhanced MRI is a more certain means of diagnosis. The fluid contents of the expanded sinus will be confirmed if there is an absent signal after contrast. Post-contrast MRI is particularly useful for demonstrating secondary mucocele formation when the underlying cause is not demon-



FIG. 1

Coronal T1-weighted MRI. The post-Gadolinium scan shows a frontal sinus mucocele (non-enhancing) secondary to a squamous cell carcinoma.

strated on CT. The non-enhancing mucocele is readily distinguished from the causative pathology (Figure 1).

Frontal sinus

The classical appearance of a frontal sinus mucocele on CT or plain X-ray is that of an opaque, expanded sinus with loss of the normal scalloped margin. It should be noted, however, that this is not a constant feature since it does not occur when only the horizontal part of the sinus is affected which occurs in approximately 25 per cent of frontal sinus mucoceles. Other changes include depression or erosion of the supra-orbital ridge and extension of the soft tissue mass across the mid-line through the septum to the opposite frontal sinus (Figures 2 and 3).

Ethmoidal mucoceles

The majority of these are found in the anterior group of the ethmoidal cells and it is sometimes difficult to distinguish whether the mucocele has arisen within a superior anterior ethmoidal cell or the frontal sinus itself when they are best referred to as fronto-ethmoidal (Figure 4). Mucoceles of the posterior ethmoid cells are less common (Figure 5) and may be occasionally associated with sphenoid mucoceles.

Ethmoid mucoceles are difficult to detect on plain X-rays but are usually obvious clinically since most present with a palpable mass at the medial canthus combined with proptosis, lateral and inferior displacement of the globe 91 per cent, 55 per cent and 59 per cent respectively.³ Epiphora may also occur when expansion of the mucocele affects the lacrimal sac or duct.

Sphenoid mucoceles

Imaging techniques play a key role in the diagnosis of a sphenoid mucocele and it is important that the condition is recognized by the radiologist at an early stage so that it



FIG. 2

Coronal CT of a frontal sinus mucocele. There is an opaque expanded sinus with loss of the normal scalloped margin and erosion of the supra-orbital ridge.

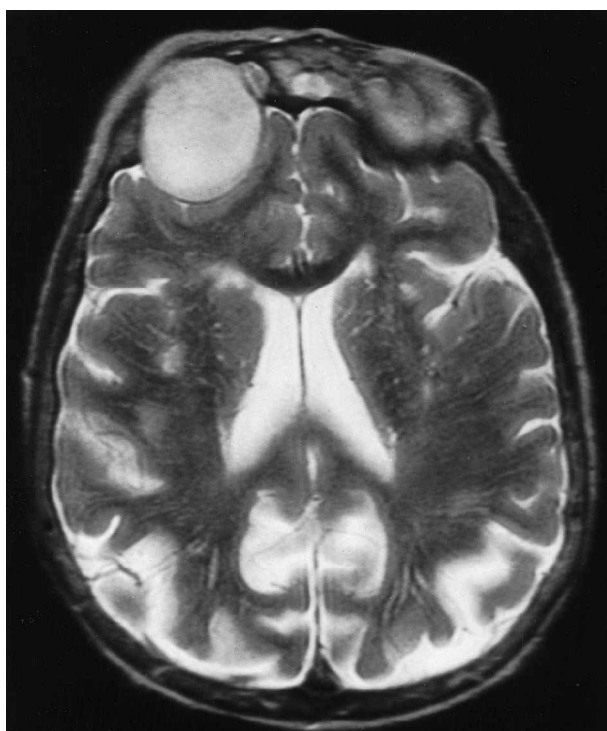


FIG. 3

Axial T2-weighted MRI showing a frontal sinus mucocele.



FIG. 4

Axial CT showing expansion of the anterior ethmoid cells due to a mucocele.

may be dealt with surgically before vision is seriously compromised. The proximity of the sphenoid sinus to the optic nerve, cavernous sinus and oculo-motor nerves means that mucocele expansion readily gives rise to symptoms resulting from involvement of these structures. Headache combined with eye symptoms such as blurred vision or diplopia are early complaints, frequently followed by visual loss. On plain radiographs sphenoid mucoceles are liable to be mis-diagnosed as pituitary tumours or a nasopharyngeal tumour invading the sphenoid; in either case this may result in inappropriate treatment.



FIG. 6

Axial CT showing a sphenoid mucocele. The ethmoids are opaque due to nasal polyposis.

In general the radiological features become more emphatic as the lesion expands the sphenoid sinus, resulting in elevation or destruction of the floor of the

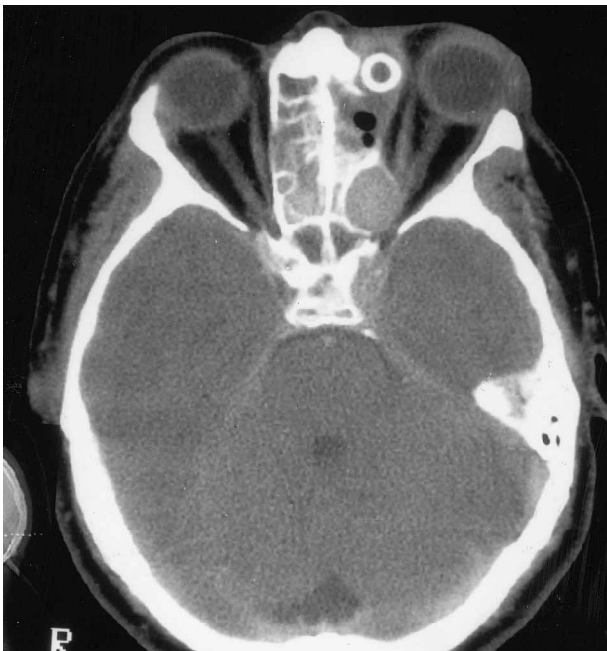


FIG. 5

Axial CT showing a small posterior ethmoidal mucocele. The patient had undergone previous external fronto-ethmoidectomy elsewhere with a frontal sinus drainage tube left *in situ*.



FIG. 7

Coronal MRI post-gadolinium showing expression of the right maxillary antrum due to a mucocele.

TABLE II
DIFFERENTIAL DIAGNOSIS

Fungal disease
Cholesterol granuloma
Odontogenic cyst (maxilla)
Neoplasia – benign
– malignant

pituitary fossa on the lateral skull film. Progressive expansion will also cause erosion of the medial wall of the optic canal and elevation of the planum sphenoidale. CT will show the typical rounded or partially rounded expansion of the sinus (Figure 6) as opposed to the destruction of bone associated with neoplasia. MRI is not always needed for diagnosis but is the optimum method for demonstrating the fluid content of the mucocele.

Maxillary mucocoeles

The maxillary antrum is a relatively rare site for mucocele formation, accounting for 10 per cent or less of mucoceles reported in Europe and the United States,⁷ odontogenic cysts or cholesterol granuloma being more common causes of expansion of the antrum. However, in Japan a large series of antral cysts or mucoceles have been described associated with previous Caldwell Luc surgery.^{8,9} Clinically the symptoms are due to sinus expansion into the nose, mouth and orbit resulting in upward displacement of the eye, proptosis and swelling of the cheek. On plain X-ray the sinus is invariably opaque and expanded and as in the other sinuses enlargement with good preservation of the sinus walls is the clue to the diagnosis. CT is indicated to

confirm the expansion and MRI will establish the fluid content of the expanded sinus (Figure 7).

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Address for correspondence:

Professor V. J. Lund,
Institute of Laryngology and Otology,
University College London,
330 Gray's Inn Road,
London WC1X 8DA

Fax: +44 171 833 9480