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# Cholesterol granuloma of the frontal sinus

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**Abstract**
It is common to see cholesterol granuloma in the mastoid air cells, less common in the orbit, and uncommon in the paranasal sinuses. Cholesterol granuloma is thought to be due to an interruption to normal aeration with impaired lymphatic drainage, resulting in a closed cavity where it may form. These expanding cysts cause bone destruction and compression of the surrounding structures that lead to clinical symptoms. Diagnosis and management of cholesterol granuloma cysts can be challenging. Magnetic resonance imaging (MRI) and computed tomographic (CT) scans are usually diagnostic. We present a rare case of cholesterol granuloma in the frontal sinus, few cases have been reported in the literature.

**Key words: Granuloma; Cholesterol; Frontal Sinus**

## Case report

A 65-year-old male was referred to the ophthalmology department with a four-year history of gradually enlarging swelling of the medial edge of the right orbit. The swelling was painless and was not associated with any nasal symptoms or headaches. He had no diplopia and cranial nerve examination was unremarkable.

On examination there was swelling on the right upper medial quadrant of the orbit, which was non-fluctuant and hard. Nasal examination was unremarkable and a CT scan revealed a completely opacified right frontal sinus with an anterior and inferior breach of the sinus (Figure 1). The opacification appeared to be due to a cystic mass lesion, which extended into the upper orbit anteriorly – it was felt this was a frontal mucocele. On further detailed questioning there was no history of trauma.

At surgery the frontal sinus was opened through a Lynch-Howarth incision, and the characteristic cholesterol granuloma contents were removed from the cavity. Histology revealed a chronic inflammatory process and a granulomatous response to cholesterol (Figure 2).

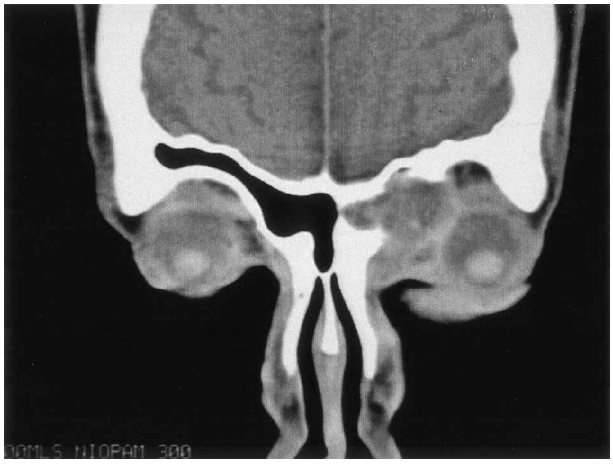

Fig. 1

A coronal CT of the Orbit. A well-defined cystic mass in the upper medial quadrant of the right orbit. The right frontal sinus is completely opacified with anterior and inferior breach of the sinus.

Fig. 2

A histology slide of the cholesterol granuloma of the frontal sinus. The fibrous connective tissue contains a focus of granulomatous inflammation characterised by a proliferation of histiocytes. The histiocytes are accompanied by cholesterol clefts and a mixed inflammatory cell infiltrate including plasma cells and lymphocytes. Foreign-body type giant cells with ingested foreign material and cholesterol are identified. (H & E; ×100)

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## Discussion

The term cholesterol granuloma is used to describe a histological entity consisting of granulation tissue in which large numbers of cholesterol crystals act as a powerful irritant and provoke foreign body giant cell formation.[1] Manasse[2] was the first to describe the foreign body cell reaction to the cholesterol crystals that were thought to cause cholesterol granuloma of the middle ear. Shambaugh[3] identified its clinical precursor, which he termed the blue-drum membrane. Hiraide[4] produced cholesterol granulomas by injecting sterile cholesterol into the guinea pig middle ear. House and Brackmann[5] were the first to describe the destructive effect of cholesterol granuloma in the petrous apex.

Cholesterol granulomas are found most commonly in patients with chronic otitis media and cholesteatoma. In a study by Niho[6] between 12 and 50 per cent of those with chronic otitis media had cholesterol crystals in their temporal bones. As a result of its association with cholesteatoma in the temporal bone, cholesterol granulomas in the paranasal sinuses have confusingly been labelled as orital cholesteatoma.[7] Cholesterol granulomas of the paranasal sinuses have been described[8–11] but are less common than their counterparts in the temporal bone.

Cholesterol granuloma formation is thought to be secondary to another pathological cause in the temporal bone and paranasal sinuses.[10] Niho[6] described how cholesterol granuloma developed from fatty degeneration occurring in the connective tissue of air cells. This occurred in patients where the ventilation was obstructed by an inflammatory lesion. The microscopic appearances of paranasal cholesterol granuloma are identical to those found in the middle ear i.e. cholesterol crystals surrounded by foreign body giant cells. The cholesterol, fat, and haemosiderin give it the gross appearance of a brownish cyst, oily in consistency, with yellowish colouration.[12]

The primary cause of a cholesterol granuloma is thought to be trauma. Males are nine times more likely to suffer with this condition than females and it normally presents in middle age. A history of trauma may have occurred years previously, but in 50 per cent of patients trauma is denied.[7] Our case denied any trauma. Trauma results in haemorrhage into a bony cavity which causes the ventilatory channels to become obstructed.

Trauma by itself is not thought to be enough. If lymphatic drainage and ventilation is impaired, preconditions are present for the precipitation of cholesterol in crystalline form,[9] but some disagreement exists about the cholesterol source. Some studies describe fatty degeneration from serum or cell breakdown,[6,13,14] whereas blood, transudate or degenerating tissue has also been implicated as the source of cholesterol.[4]

In spite of the similarity between cholesterol granuloma in the paranasal sinuses and temporal bones it is still a condition that it seen very rarely in the paranasal sinus when compared to the middle ear.

Cholesterol granulomas of the maxillary sinuses are well known to otolaryngologists; very few cases have been reported in the frontal sinus. Lesions that resemble cholesterol granuloma are chronic osteomyelitis and mucocele of the frontal bone. It is clinically difficult to distinguish between cholesterol granuloma and mucocele of the frontal sinus as both lesions produce a characteristic swelling of the fronto-orbital area and compression of the surrounding structures, that produces symptoms. They can be distinguished on radiological and histological investigation. CT findings are non-specific but MRI can be characteristic. On CT, both lesions appear homogeneous with expansion and de-aeration of the sinus and encroachment on the cranial and orbital cavities. If the inner table of the frontal bone is eroded, dura may be exposed. On MRI, the cholesterol granuloma emits high signal intensity on both T1- and T2-weighted images. These signal intensities reflect the peripheral accumulation of paramagnetic free methaemoglobin.[14] This hyperintensity is enhanced by the intravenous administration of gadolinium.[15] On the other hand, mucocele on MRI shows low signal intensity on both T1- and T2-weighted images. A mucocele that has had previous surgical intervention appears as high signal on both T1 and T2-weighted images, in keeping with haemorrhage.[16]

Histologically, cholesterol granuloma is characterized by granulation tissue formation, the presence of haemosiderin, histiocytes, and most importantly by the presence of fusiform clefts, representing the sites where cholesterol was present prior to removal by tissue processing. These cholesterol clefts may be extracellular or present within multinucleated giant cells, hence the description as cholesterol granuloma. The histological features of a frontal sinus mucocele are the presence of cyst wall fragments with a lining composed of respiratory epithelium, variable flattening and attenuation of the pseudostratified columnar epithelium, scattered goblet cells, and varying degrees of epithelial hyperplasia and squamous metaplasia of the mucocele lining. There may be submucosal fibrosis and evidence of chronic inflammation, with an infiltrate of lymphocytes, plasma cells and eosinophils.[17]

## Conclusion

Cholesterol granuloma of the frontal sinus is a rare condition. It can present with ophthalmic manifestations such as proptosis. Being a benign and curable lesion, early recognition and management is of paramount importance. Prior to surgery cholesterol granuloma has to be considered in the differential diagnosis, especially with bone involvement and history of trauma. Appropriate radiological assessment is necessary for the diagnosis. MRI scan may be useful to confirm the diagnosis as it gives better soft tissue differentiation.

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