Frontal sinus cholesterol granuloma: Case report

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ABSTRACT

A case report of a massive cholesterol granuloma (CG) of the frontal sinus in a 15-year-old male subject treated endoscopically is reported. CGs are slowly expanding, cystic lesions that are rarely observed in the frontal sinus. Frontal sinus CGs characteristically present with proptosis, diplopia, and a unilateral painless expanding mass above the orbit. Patients frequently report a history of chronic nasal obstruction or head trauma. Although the pathogenesis is unclear, it is likely multifactorial in etiology. Surgical resection via *endoscopic sinus surgery has been gaining popularity because of the minimally invasive approach and lower rates of recurrence.*

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Cholesterol granuloma (CG) is a histological entity consisting of granulation tissue in which large numbers of cholesterol crystals within an enclosed space act as a powerful irritant and provoke foreign body giant cell formation.[1] They are most commonly found in patients with chronic otitis media and cholesteatoma in the middle ear or mastoid portion of the temporal bone.[2] CGs of the paranasal sinuses have been previously reported.[3–5] Despite the benign nature and rare occurrence of CGs of the frontal sinus, it remains an important element in the differential diagnosis of frontal sinus masses associated with destruction of bone and orbital complications.

CASE REPORT

A 15-year-old male subject presented to our clinic with double vision for a period of 3 weeks. He also noted a lump above his right eye accompanied by worsening facial pressure. He denied any nasal drainage, congestion, fevers, or postnasal drip. Medical history was significant for head trauma 5 years before his presentation that required a decompressive craniotomy on the left side.

On exam, he had proptosis of his right eye as well as swelling/deformity at the right frontal region. The rest of his head and neck exam was normal. Computed tomography (CT) scan of the paranasal sinuses was performed and showed a right frontal sinus expansion accompanied with erosion of the superior orbital wall and the skull base. The CT scan showed three separate compartments of the lesion with the largest far lateral (Fig. 1 *A*). Further imaging with magnetic resonance imaging (MRI) was performed to better characterize the lesion, which showed a hyperintense lesion on both T1 and T2 with depression of the superior orbit (Fig. 1, *B–C*).

The patient was taken to the operating room and a Draf III procedure (modified endoscopic Lothrop) was performed with mucosal graft modification as previously described.[6] A yellow granular substance was encountered on opening the right frontal sinus. Complete marsupialization of the granuloma was performed with drainage into the nasal cavity and a portion of the cyst wall was sent to pathology (Fig. 2). The pathology was consistent with GC.

DISCUSSION

The inciting event that spawns the development of a CG remains unclear.[1,7–9] Originally, it was thought that the primary cause was trauma, including previous sinus surgery. However, recent literature reviews of paranasal sinus CG report that only 25% of patients elicited a history of trauma or previous surgery.[8] Chronic nasal obstruction, such as by a middle nasal polyp or chronic sinusitis, is also thought to be the cause of CG.[4,9]

CGs may form in response to hypoventilation or occlusion of air cells. Hypoventilation results in the hemosiderin deposition into the enclosed space, which then forms cholesterol crystals. An inflammatory macrophage-mediated granulomatous reaction is triggered causing expansion of the mass and subsequent bony erosion.[7] Niho *et al.* proposed that cholesterol deposition within the sinus results from fatty degeneration of serum or cell breakdown.[1,2,10] Alternatively, Hiraide proposed the source of cholesterol is from blood, transudate, or degenerating tissue.[1,11] The etiology of the cholesterol in the space remains unclear and may be multifactorial.

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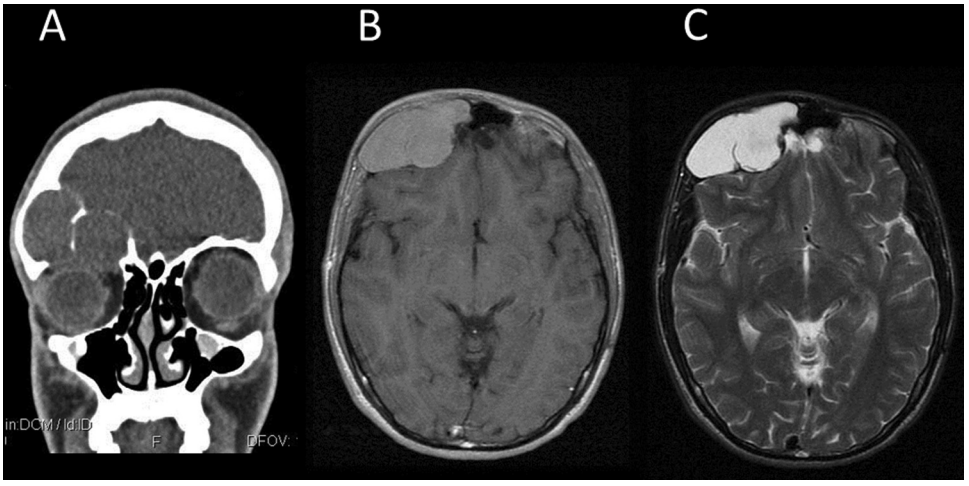

Figure 1. (A) Coronal computed tomography (CT) scan of frontal sinus cholesterol granuloma (CG) displaying bony erosion of the superior orbital wall and skull base. (B) T1 and (C) T2 magnetic resonance imaging (MRI) shows a hyperintense appearance characteristic of a CG.

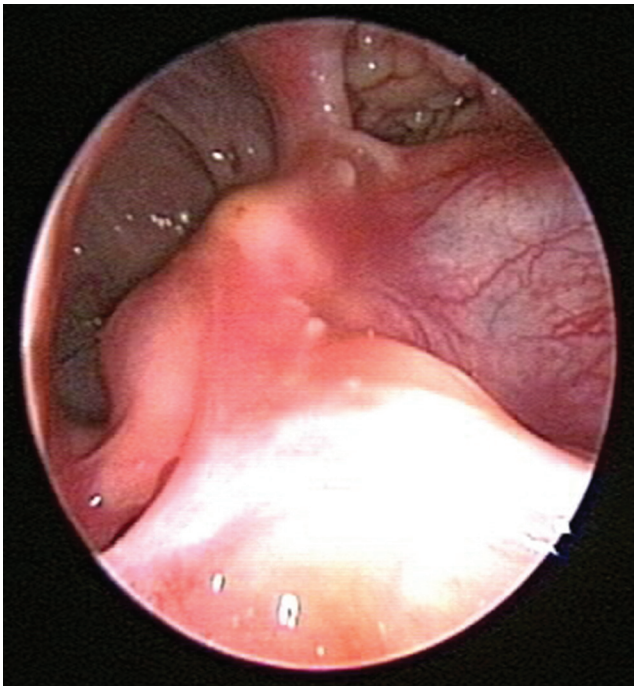

Figure 2. Draf III procedure at 6 months with widely patent cavity and no evidence of persistent cholesterol granuloma (CG).

In the current case, head trauma could have resulted in bleeding into the frontal sinus with subsequent obstruction and hypoventilation. The blood retained within the sinus likely underwent hemosiderin catabolism, resulting in cholesterol crystals that serve as the nidus for the granulomatous inflammatory response.[9] Trauma by itself is not thought to be enough to cause a CG, rather lymphatic drainage and ventilation must also be impaired to set up the preconditions for the precipitation of cholesterol in crystalline form.[1,4]

There are no characteristic signs and symptoms of a frontal CG. It most commonly presents as a unilateral, painless, slow-growing mass. The symptoms are related to extension of the granuloma into the orbit or eroding through the roof of the orbit causing frontal headache, proptosis, or diplopia.[4,9] On exam, bulging of the forehead and lateral–inferior displacement of the eye may be found.[9] In contrast, an orbitofrontal CG causes medial–inferior displacement of the eye because the orbitofrontal CG arises adjacent to the lacrimal fossa.[12]

Imaging is helpful in evaluating the differential diagnosis of a frontal sinus mass; however, there are no pathognomonic imaging characteristics of CG. On CT, a CG will appear homogeneous with expansion and deaeration of the sinus and encroachment of the cranial and orbital cavities.[1] However, a mucocele shares this radiographic finding. Considering a mucocele can also cause swelling of the fronto-orbital area with compression of adjacent structures, an MRI is helpful in differentiating a CG from a mucocele. On T1- to T2-weighted MRI, a CG appears as a hyperintense mass caused by the cholesterol component, except for at the margins of the cyst. After contrast, there is traditionally no central enhancement of the CG. On the other hand, a mucocele has a low signal intensity on T1-weighted images and low or high intensity on T2-weighted images, depending on the duration and degree of fluid content of the mucocele.[8] A three-dimensional bone CT of the skull can be useful to image the bone destruction and help guide surgical approach and decision making.[9]

The treatment of a GC of the frontal sinus cavity depends on the size and extent of the destruction. Smaller granulomas without extension may be treated with drainage of the cysts contents. Larger granulomas that have involved bone are better treated through an open or endoscopic sinus approach. Many of the reported cases in the literature of a frontal CG were treated by oculoplastic surgeons by an anterior or lateral orbitotomy *via* a brow incision with aspiration of contents and curettage of the lining, although the choice of performing an open procedure is likely because of training bias considering the lack of endo-

scopic training by most oculoplastic surgeons.[8] Recent advances in endoscopic sinus surgery have shown that such a technique offers a more minimally invasive approach to removing CG while also having the benefit of reduced rate of recurrence.[8] In our case, a Draf III procedure was performed to provide access and complete marsupialization of the CG. Our experience using mucosal grafts in Draf III procedures for frontal pathology has been very successful with 100% patency rates.[6] These grafts cover the anterior and lateral frontal sinus neo-ostium that, in the standard technique, is left to mucosalize. This could potentially lead to osteitis, which has been suggested to cause inflammation and ostial stenosis.[13]

CONCLUSION

GC of the frontal sinus is a rare finding that should be considered in the differential diagnosis of frontal sinus tumors. Characteristically, they present as a unilateral, painless, slow-growing mass associated with ocular symptoms secondary to mass extension and bony erosion around the orbit. Patients commonly have a history of trauma or previous sinus surgery, although this history is not necessary. The pathogenesis is still being elucidated. Although the lesion is benign, early detection and removal is crucial before the lesion extends through bone causing morbidity and potentially mortality if it expands into the anterior cranial fossa. MRI is the most useful imaging test to differentiate a CG from a mucocele. Although open surgical approaches are more common, endoscopic sinus surgery likely provides less morbidity.

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