Frontal Sinus Mucopyocele Presenting as a Subcutaneous Forehead Mass

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Mucocles of the paranasal sinuses are benign, chronic, expanding lesions that characteristically develop because of obstruction of the sinus ostium. The frontal sinus is the most common sinus to be affected by a mucocle, which usually results from trauma or inflammatory processes. Patients with these lesions frequently present with visual complaints of decreased visual acuity, visual field abnormalities, proptosis, ptosis, displacement of the globe, or restricted ocular movements secondary to erosion through the thin bone of the superior orbit and compression on the globe. Often, intracranial extension of frontal sinus mucocles is also present from erosion through the posterior table of the frontal sinus. Very rarely, they will present as a subcutaneous forehead mass or swelling. To the best of our knowledge, only 5 cases of a frontal sinus mucocle presenting as a forehead subcutaneous mass has been previously reported. We report the case of an 80-year-old woman with a history of remote forehead trauma who presented with a frontal sinus mucopyocele manifesting as a subcutaneous forehead mass eroding through the skin.

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Mucocles of the paranasal sinuses are benign, chronic, expanding lesions, filled with sterile mucus and epithelial cells.¹ They characteristically develop from a continuous or intermittent obstruction of the sinus ostium, which causes dilatation of the sinus cavity secondary to accumulation of mucoid material.² This subsequently causes displacement of the surrounding structures through bony destruction of the adjacent sinus walls.³ The frontal sinus is the most common sinus to be affected by a mucocle, which is generally the result of trauma or inflammatory processes or develops iatrogenically from previous sinus surgery.¹,⁴,⁵ Patients with these lesions frequently present with visual complaints secondary to orbital involvement. The visual complaints include diplopia, decreased visual acuity, visual field abnormalities, proptosis, ptosis, periorbital swelling, displacement of the globe and restricted ocular movements.³,⁶ Often, intracranial extension of frontal sinus mucocles is also present from erosion through the posterior table of the frontal sinus. This can result in complications such as meningitis, meningoencephalitis, pneumocephalus, brain abscess, seizures, and cerebrospinal fluid (CSF) fistulas.²,³,⁷ Very rarely, they will present as a forehead mass or swelling. To the best of our knowledge, only 5 cases of frontal sinus mucocle presenting as a forehead subcutaneous mass or swelling have been previously reported.²,⁸-¹¹ We present the case of an 80-year-old woman with a history of remote forehead trauma who presented with a frontal sinus mucopyocele manifesting as a subcutaneous forehead mass eroding through the skin.

Case Report

An 80-year-old woman presented to the emergency department (ED) for evaluation of a recent growth along her forehead. Approximately 45 years earlier, College of Dentistry, 3302 Gaston Avenue, Dallas, TX 75246; e-mail: david.kang@baylorhealth.edu
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FIGURE 1. A, Computed tomography (CT) axial soft tissue window demonstrating the erosion of the mucopyocele into the soft tissue of the forehead. B, CT axial bone window demonstrating erosion of the mucopyocele through the anterior table of the frontal sinus.

she had been struck in the face with a lamp by her ex-husband and had experienced fractures to the face and a significant laceration. She did not undergo any surgical intervention at that time other than closure of the soft tissue lacerations. Recently, she had hit her forehead on the corner of an open kitchen drawer as she crouched down to pick up a dropped utensil. Approximately 1 week later, her forehead began to swell and she presented to the ED. Computed tomography scans were performed and revealed obliteration of her left frontal sinus and left ethmoid sinus, with a nickel-size erosion of her frontal bone, and a mass extending from the sinus into the subcutaneous tissues (Fig 1).

On clinical examination, a midline forehead mass was evident between the eyebrows and extended inferiorly past the nasofrontal junction and superiorly to the middle half of the forehead. The lesion appeared to be warm and fluctuant and was approximately 4 cm wide and extended 6.5 cm vertically, with a central area of erythema (Fig 2). She denied experiencing any ocular or neurologic symptoms or any notable drainage from her nose or eyes. The remainder of her physical examination findings was unremarkable.

From the clinical and radiologic findings, the most likely diagnosis was a mucopyocele that had eroded through the anterior table of the frontal sinus. We suspect that her facial trauma 45 years earlier might have compromised her nasofrontal duct, leading to the development of a mucocele that slowly eroded and thinned the anterior table of the frontal sinus. Her recent trauma might have fractured the paper-thin anterior table, allowing the mucopyocele to erode and expand through the anterior table of the frontal sinus into the soft tissue of the forehead.

She was then sent home in preparation for surgery; however, within 3 days, she returned to the ED with ulceration and drainage from the forehead (Fig 3). The drainage was cultured, and she was given ampicillin/sulbactam (Unasyn) and scheduled for surgery. A coronal flap was elevated down to the level of the perforation of the frontal bone, and, with gentle manipulation, the purulent drainage was identified and the mucopyocele curetted and removed. The specimen was then sent for culture and pathologic examination (Fig 4). The frontal sinus was then burried down to completely remove the mucosa. The nasofrontal duct was explored through the ethmoid sinus to establish drainage to the nose.
A bilobed pericranial flap was elevated as the central component was disrupted from the fistula tract (Fig 5). The fistula tract through the forehead skin was then excised in an elliptical fashion (Fig 6). The nasofrontal duct was occluded with bone chips and sealed with Floseal (Baxter International, Deerfield, IL). The left frontal sinus was obliterated using the contralateral pericranial flap (Fig 7), and the bony defect was repaired using titanium mesh (KLS Martin, Jacksonville, FL). The ipsilateral pericranial flap was then placed over the mesh, and the scalp was closed in a layered fashion with the skin closure completed in a subcuticular fashion (Fig 8) using a Quill Monocryl suture (Surgical Specialties Corp, Vancouver, BC, Canada). One flat channel drain was placed and was removed on the second postoperative day.

The final pathologic examination revealed findings consistent with mucopyocele, and final cultures revealed pan-susceptible *Staphylococcus* species and *Fusobacterium* species. She was given a 1-week course of amoxicillin/clavulanic acid (Augmentin), and the remainder of her postoperative course was unremarkable (Fig 9).

**Discussion**

Paranasal mucoceles most commonly affect the frontal sinus (60%), with most of the remainder involving the ethmoid labyrinth and maxillary and sphenoid sinuses. The 2 most frequent causes of frontal sinus mucoceles are trauma and inflammatory changes. Obeso et al noted in a retrospective study of 72 patients presenting with paranasal mucoceles that 35% had undergone previous sinus surgery and 14% had had previous facial fractures, suggesting that some mucoceles might be iatrogenic.

Post-traumatic mucoceles can present from 2 months to up to 50 years or longer after the original injury. Because of the often slow-growing nature of frontal sinus mucoceles and the demographic data of trauma patients, very few patients have a well-documented history of trauma to the frontal sinus. In a published data review and experience from their institution, Koudstaal et al identified only 13 patients with a history of trauma to the frontal sinus preceding the development of a mucocele, a remarkably small number when one considers the incidence of frontal sinus mucoceles.
sinus fractures. Several strategies have been suggested for the treatment of frontal sinus fractures, with most treatment decisions predominantly depending on involvement of the anterior wall, posterior wall, intracranial involvement, and nasofrontal duct. A key element to the successful treatment of patients with frontal sinus fractures is an understanding of frontal sinus drainage and whether the nasofrontal duct has been injured. When the frontal sinus drainage is impaired and the mucus is retained, a mucocele can develop. Therefore, it has been recommended that fractures of the frontal sinus that cause obstruction of the nasofrontal ducts should be treated by complete sinus membrane removal and obliteration of the sinus cavity.

Frontal sinus mucoceles can occur at any age in both genders. However, most are seen between the fourth and seventh decades of life. If the mucocele becomes acutely infected, it is termed a mucopyocele. It can present with subtle or overt signs of infection and additionally carries the risk of sepsis and meningitis. Mucoceles typically expand in the direction of least resistance; therefore, frontal sinus mucoceles tend to erode the thinner bone of the superior orbit and subsequently will displace the globe inferiorly, which can result in diplopia, decreased visual acuity, visual field abnormalities, proptosis, ptosis, periorbital swelling, displacement of the globe, and restricted
oculomotor movements. Other sequelae include meningitis, meningoencephalitis, pneumocephalus, brain abscess, seizures, chorioretinal folds, and CSF fistulas.

The diagnosis is determined by clinical examination, with the aid of computed tomography (CT) and magnetic resonance imaging (MRI). CT with contrast is the preferred method of imaging, although MRI is useful in complicated cases with intracranial extension or infection because of its superior ability to identify the relationship of the mucocele with the brain, orbit, and soft tissues. The CT findings of a mucocele will demonstrate an expanded sinus with gradual thinning and erosion of the bony margins of the frontal sinus, with the posterior wall and orbit particularly prone to erosion because of its inherent thinness. The anterior wall of the frontal sinus is uniformly thicker and stronger than the posterior wall, which is likely the reason that anterior table erosion is less commonly seen. A rarely reported presentation of frontal sinus mucoceles is when the mucocele extends anteriorly into the subcutaneous region and presents as a forehead mass or forehead ulcer. Fernandes and Pirgousis reported on a 59-year-old woman who presented for a longstanding frontal mass that had been present and continually enlarging for at least 10 years. She had marked extra-axial proptosis and displacement of the orbital cavity with the resultant complete loss of vision and light perception in the affected eye. Borkar et al reported on a 53-year-old woman with a frontal mucocele with cranio-orbital extension that presented with slowly progressive swelling of the left forehead without any preceding trauma or paranasal sinus surgery. Akiyama et al reported on a 57-year-old woman also with a frontal sinus mucocele with cranio-orbital extension who presented with a 3-month history of an asymptomatic tumor of the forehead. Tan et al reported on a 33-year-old woman with visual complaints of blurring of the inferior visual field, periorbital swelling, and a painless subcutaneous forehead mass above the affected eye. She had no history of trauma or previous surgery. CT and MRI studies showed a mass that had also eroded into the orbit and intracranially with a subcutaneous forehead component. Altintas Kaksi et al reported a case of an 80-year-old woman who had presented with a nonhealing ulcer on her forehead and also had no history of trauma or previous surgery. She had no associated ocular or neurologic symptoms, and imaging demonstrated a frontal sinus mass with a 3- to 4-mm defect on the anterior wall of the frontal sinus and a 3-mm sinus tract opening to the skin of the forehead.

The treatment modalities for the prevention of mucocele formation include observation, cranialization, obliteration, and nasofrontal duct stenting. The prevailing principles for these procedures involve either maintenance of normal sinus function by maintaining nasofrontal duct patency or removal of all remaining sinus mucosa and isolation of the sinus from the nasal cavity and cranium. Definitive treatment of frontal sinus mucoceles is surgical, which varies from functional endoscopic sinus surgery to craniotomy and craniofacial exposure with or without obliteration of the sinus. If the mucocele cannot be approached endoscopically and thus lasting drainage function cannot be guaranteed, an extranasal, transfacial procedure is indicated. Important objectives of operative therapy include reliable santiation of the mucocele, incorporating management of intracranial or intraorbital complications; drainage of the mucocele into the nose, either by preservation or extension of the natural nasofrontal duct or complete removal of the mucocele and the mucosa of the frontal sinus and reliable closure of the nasofrontal duct; preservation or reconstruction of the anterior wall of the frontal sinus to protect the frontal lobe and maintain the contour of the forehead. When the posterior wall of the frontal sinus is eroded and the dura is involved, the most common treatment modality is radical extirpation of the mucocele, cranialization, and nasofrontal duct obliteration through transcranial access. The success of obliteration depends on the careful extirpation of the mucosa, permanent closure of the nasofrontal duct, and the choice of appropriate obliteration material. Obliteration of the nasofrontal duct aims to prevent an ascending frontal sinus infection and prevent the growth of the nasal mucosa upward into the frontal sinus.
sinus. To date, no consensus has been reached on the ideal obliteration material.1

Because mucoceles can develop years after trauma without any peak in incidence, it has been advocated that patients who have sustained frontal sinus injuries be monitored for life and that these patients should be informed of the possibility of mucocele development to be aware of the possible symptoms over time.13 The most sensitive follow-up modalities for early mucocele detection are CT and MRI.3,25

In conclusion, frontal sinus mucoceles and mucopyoceles are infrequent occurrences and rarely present as a subcutaneous forehead mass. The present case demonstrates that a subcutaneous soft tissue swelling or mass on the forehead can be the initial presenting sign of a frontal sinus mucocele or mucopyocele, reminding us of the importance of life-long follow-up in patients sustaining frontal sinus injuries.

References