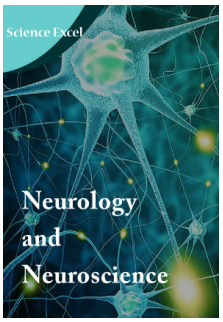
Neurology & Neuroscience

Case Report



External Frontal Sinostomy to Drain Frontal Lobe Abscess

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Keywords

FESS [Functional Endoscopic Sinus Surgery], Frontal lobe brain abscess, C&S [Culture and Sensitivity], CNS [central nervous system], Frontal Sinusitis, External Frontal Sinostomy, GCS [Glasgow Coma Scale].

Abbreviations

FESS: Functional Endoscopic Sinus Surgery; C&S: Culture and Sensitivity; CNS: central nervous system; GCS: Glasgow Coma Scale

Abstract

A case of frontal sinusitis with osteomyelitis of its posterior wall producing frontal lobe brain abscess is presented, whereby the posterior wall dehiscence was exposed by external sinostomy by an ENT surgeon and then, through the dehiscence, the abscess was drained by a neurosurgeon. This is an uncommon technique of draining a frontal lobe brain abscess where no frontal bone craniotomy was required. This approach yields the least damage to the cerebral tissue as the frontal abscess was very close to posterior wall of frontal sinus and drain has to travel through minimal intracerebral distance.

Introduction

Frontal sinusitis typically presents as frontal headache, fever, tiredness, and tenderness over the sinus, affecting about 15% of the adult population. These sinuses are paired, separated by an intersinus septum and can present as an isolated sinus disease. If left untreated then, due to its proximity to several vital structures, complications can be catastrophic and may include both orbital and intracranial [9]. Intracranial extension of acute or chronic sinusitis has a reported incidence of 3.7% to 11% in hospitalized patients [1] and are commonly seen in the first 2 decades of life as this age group is most prone to sinus disease [2]. Though the clinical incidence is low there should be a high index of suspicion for intracranial infections in the presence of etiologies like trauma, a frontal sinus abscess or focal neurologic symptoms with a sinus disease. [3]. Early diagnosis and treatment is essential to avoid devastating neurologic disability. Brain abscess is a rare but life-threatening condition which may result from contiguous site infection, hematogenous seeding, penetrating traumatic injuries, neurosurgical procedure, or cryptogenic source. Morbidity over the course of intracranial sinusogenic complications has been decreasing with the introduction of new-generation antibiotics, development in diagnostic techniques, improvement in rhinosurgery, and, especially, the introduction of neuronavigation. Before the introduction of newer antibiotics, the morbidity of complications reached approximately 80% [4], nowadays it is from 5% [5]. Permanent changes, such as epileptic seizures, palsy, impairment in mental function, etc. are observed in approximately 30% of the patients [7].

Pathogenesis

The inflammation of the external layer of dura mater and epidural empyema usually develops in the areas in which the osseous wall of the sinus adheres tightly to dura mater. If there is a lesion affecting the posterior wall of the frontal sinus, the surgeon has to uncover dura mater in order to search for the epidural empyema. After removing its posterior wall and exposing dura mater within the anterior cranial fossa, the epidural empyema and/or subdural empyema can be evacuated.

Drainage of brain abscess

Usually, the so-called closed treatment technique using Zakrzewski's method is used for brain abscess drainage where, after craniotomy, the abscess is punctured and its contents are gradually replaced with progressively decreasing concentrations of weak crystalline penicillin solution in physiological saline [8,12]. In an encapsulated abscess, this method allows a constant pressure to be kept inside the abscess cavity thereby decreasing trauma to the cerebral tissue. Healing of the abscess after a single puncture and replacement of its contents has been observed.

Case Report

A 15-year-old boy from a squatting area of Georgetown, Guyana, presented at A&E department with complaints of severe frontal headache, high fever, neck stiffness,

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Figure 1. *Demonstrating vasogenic edema around the abscess of the left frontal lobe.*

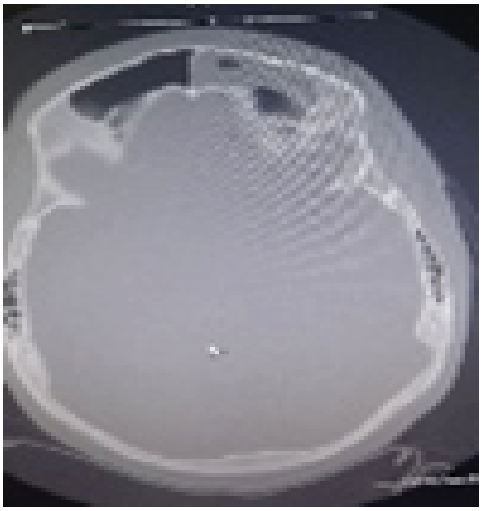

Figure 2. *Demonstrating sinus disease in left frontal sinus.*

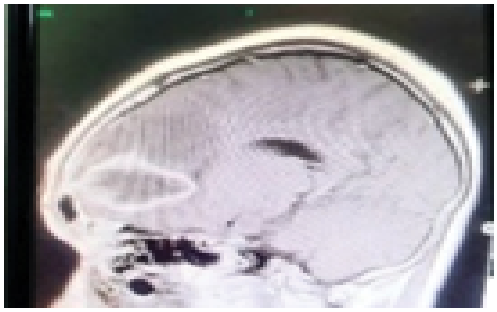

Figure 3. *Showing the frontal lobe abscess close to post wall of the frontal sinus. Contrasted magnetic resonance imaging noting the circumscription of the abscess.*

Figure 4. *External approach to left frontal sinus's anterior wall.*

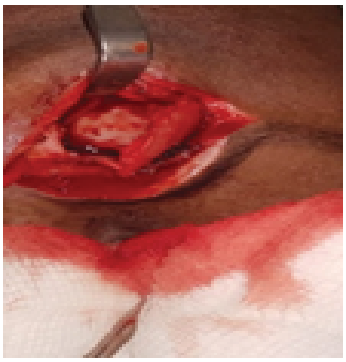

Figure 5. *Posterior wall of sinus exposed through the anterior wall window*

photophobia and vomiting of two weeks' duration. He had a GCS of 14/15. In his recent medical history, he was treated for cough and cold about two weeks earlier. A clinical diagnosis of meningitis was made and he was admitted. A CT scan of brain was advised which revealed a space-occupying lesion [an oval collection with air-fluid level] in left frontal lobe with perilesional edema and a mass effect (Figure1). It also showed isolated left Frontal sinusitis (Figure 2) and a small bone erosion of the posterior wall of frontal sinus. The frontal lobe brain abscess was in close proximity of posterior wall of the frontal sinus. Further, a MRI also revealed a three cm size oval encapsulated lesion with fluid content, close to the posterior wall of left Frontal sinus, supero-medially (Figure 3). For these reasons, he was diagnosed as having a left frontal sinusitis with intracranial complication - left frontal lobe brain abscess, treatment was started with I.V. Rocephin, Flagyl and Steroids along with mannitol. Clinically, the patient showed no signs of improvement, hence a decision was made to surgically access the abscess and drain it through the dehiscent posterior wall of the frontal sinus, not through frontal craniotomy. The frontal sinus pathology was removed by two routes. First, a FESS procedure was done to clean the left EthmoidoFrontal sinuses and secondly, an external left frontal sinostomy was made to assess the posterior wall of the frontal sinus by making a replaceable window [bony flap] around 1.5 cm in diameter on anterior wall of left frontal sinus. The left frontal sinus was exposed by a bone deep skin incision just above left eye brow and through the window in its anterior wall, [Figures 4 and 5] the sinus cavity was exposed to find thickened mucosa,

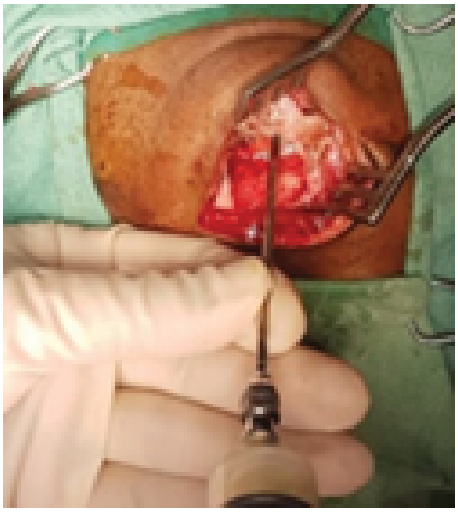

Figure 6. *Aspiration of left frontal lobe abscess through the post wall of left frontal sinus.*

Figure 6. *Irrigation of left frontal lobe abscess through the post wall of left frontal sinus.*

granulations which were curetted out, and a small bone erosion was detected on the posterior wall at the superomedial aspect. The same erosion was slightly widened by the neurosurgeon to expose dura. A trocar was slowly introduced to reach the encapsulated abscess which was gradually aspirated [repeated 1.5 cc volume irrigations with normal saline] about 10 cc of light-yellow colored pus was extracted and sent for culture and sensitivity (Figures 6 and 7). A drain was placed in aspirated abscess cavity and was taken out through a separate incision under the skin from the lateral aspect of left frontal region. A separate drain was placed in the frontonasal duct to drain the frontal sinus through the left nostril. The intracranial drainage was found to be minimal and both drains [nasal and Dural] were removed after 4 days. The culture reports were negative and the patient was discharged on oral antibiotics for 6 weeks along with an anticonvulsant drug for one year. Post-operative follow up CT scan were done after 4 weeks and 5 months, showing a good resolution (Figures 8 and 9).

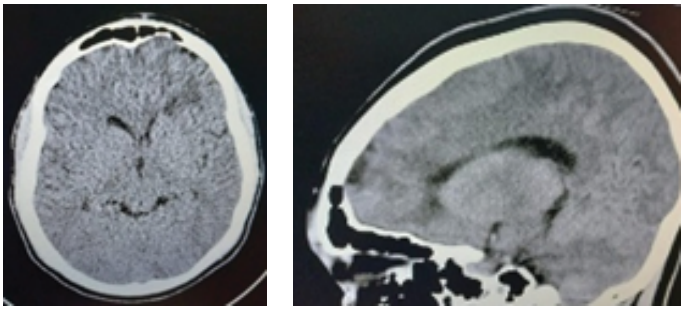

Figure 8. *Post op- Perilesional edema [after 4 weeks]. CT scan shows areas of ill-defined hypo-attenuation seen extending through the anterior frontal region suggestive of post-surgical changes of previously demonstrated abscess with acute edema.* .

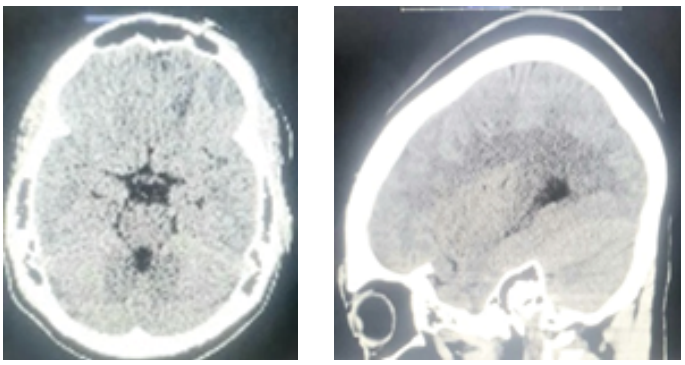

Figure 9. *Post op- CT Scan [after 6 months], good resolution.*

Discussion

The Central Nervous System (CNS) is incapable of mounting a large immune response, permitting rapid spread of infection and extensive tissue damage and so potentially leaving the patient with long-lasting, severe neurologic deficits. Sinusogenic intracranial complications are observed less frequently than e.g. otogenic complications [6]. Intracranial sinusogenic complications usually result from the topographical relationships between paranasal sinuses and the anterior and middle cranial fossae. In most cases, the origin of the complications is found within the inflammatory lesion in the frontal sinus, ethmoid cells, sphenoid sinus, and, less frequently, the maxillary sinus. These complications develop more frequently as a result of chronic exacerbated sinusitis. However, they may also develop in acute viral and bacterial sinusitis, through traumatic bone loss, incomplete endoscopic nose and sinus surgery, or improperly performed procedures from the external approach [7]. The spread of infection via lymph vessels, preformed openings and canals, e.g. of the olfactory and optic nerve, cannot be excluded. The osseous wall may be intact macroscopically and hence why brain abscess cannot be excluded. The inflammation of the cancellous diploe of flat osseous walls of the cranium, in particular the frontal sinus, plays a significant role in the development of complications. A vast web of venous vessels (veins of Breschet), a homogenous system of venous canals has

numerous connections with veins of the skull sheath, dura mater veins and frontal lobe veins. Infected thrombi, lack of valves, close relationship to the mucous membrane of the osseous walls of the sinus results in making osteomyelitic foci develop within the walls, most frequently in the frontal sinus. Flat bones may be less resistant to inflammation in young patients so these patients are more prone to development of osteomyelitic intracranial complications. "Pott's Puffy Tumor" is classically associated with frontal bone osteomyelitis. Sinusogenic subdural empyema, particularly in young males, may be the consequence of retrograde spread of the infection from septic marrow thrombophlebitis in the posterior wall of the frontal sinus [5]. As compared to a brain abscess, a subdural empyema has more severe clinical course as subdural space does not contain any barriers to stop the infection from spreading.

While modern antibiotic therapy has proven effective in treating sinus disease, long-term disease that is untreated, or incompletely treated, predisposes a patient to intracranial extension of infection. Intracranial complications include the formation of a brain abscess, subdural empyema, meningitis, cavernous sinus thrombosis, epidural abscess, or osteomyelitis [2]. These complications can occur as a single entity or in any combination. The clinical symptoms of intracranial sinusogenic complications may include non-specific syndrome of increased body temperature, headache, stupor, consciousness disorder, focal neurological symptoms, seizures etc. [5]. Typically, infections from orbital, dental or sinuses tend to affect the frontal lobe, whilst infections of otogenic origin mainly affect the temporal lobe. Most often, CNS complications are the result of retrograde thrombophlebitis of the dipole veins via frontal, ethmoidal, or sphenoidal sinus disease [1].

The clinical presentation of these patients can be highly variable making diagnosis difficult. As it relates to frontal sinusitis with CNS complications, subdural empyemas are associated with rapid clinical deterioration accompanied by profound secondary neurologic deficits, while a brain abscess is associated with a more indolent and slowly progressive course. The difference is primarily due to the ability of the infection to rapidly spread in the subdural space, causing extensive mass effect on the brain. MRI scans of the brain has made it possible to determine the location of the abscess, its shape (simple, multiloculated, multiple abscesses), the state of its capsule, the edema of the brain cerebral tissue surrounding the abscess, the presence of accompanying epidural and subdural empyemas, and to monitor treatment efficacy. MRI is superior to CT in the visualization of abscesses at their early stages of development. A mature abscess exhibits an enhancing capsule which surrounded the hypodense center and which was surrounded by a hypodense picture of the brain edema. A CT scan, with or without contrast, is suitable to identify most cases of sinusitis and associated intracranial processes. If the CT is inconclusive in the setting of a high level of clinical suspicion, then MRI is recommended for confirmation [6]. Lumbar puncture is usually not indicated except in patients where a mass lesion has been ruled out and a diagnosis has not been established.

Differential diagnosis

The differential diagnosis should include viral meningitis and cerebritis, other forms of bacterial meningitis, cerebral vessel thrombosis, disseminated encephalomyelitis, abscesses of other origin – e.g. otogenic or hematogenous. If fever is not observed, differential diagnosis should include mainly primary and metastatic brain tumors, strokes and subdural hematomas.

Treatment

Small abscesses (i.e. < 1cm) within the frontal and parietal lobes are treated using an MRI- evaluation guided intravenous antibiotic therapy and should include broad-spectrum antibiotics aimed at pathogens that commonly colonize the upper respiratory tract including staphylococcus, streptococcus, and anaerobes. In the case of rare intracranial complications, anaerobes and anaerobic streptococci are the most common causative bacterial pathogens. However, in 20% of the cases [as in the presented case] no organism was isolated. Appropriate antibiotic therapy should be tailored to positive culture results and continued for 6 weeks. Approximately 40% of patients suffer from seizures during the initial stage of illness hence early administration of anticonvulsants is recommended and should be continued for 12 to 18 months or any duration specified by neurology or neurosurgery consultation [1] .

Although endoscopic sinus surgery [FESS] has been established to be effective in the management of orbital complications, its role in the management of intracranial complications is still unclear. Typically, its role is seen in cases of subdural empyema where there is direct extension of the infection from the sinus and drainage of the intracranial purulence can be achieved by a definitive surgical management for the affected sinus [9].

In case of intracranial abscesses, emergent surgical drainage is often needed, allowing for the collection of intra-operative cultures. Success rate depends upon an early diagnosis, implementation of antibiotic therapy and simultaneous performance of nose, sinus and intracranial surgery. Moderate to bigger size empyemas of frontal lobes are drained or aspirated by performing frontal bone craniotomies .The intracerebral tissue damage during its drainage by the penetrating aspirating needle or drain. An intracerebral abscess with close proximity to anterior base of skull can be drained through endonasal trans- ethmoidal endoscopic sinus surgery also, an alternative to craniotomy [10,11]. Szyfter W. et.al studied 51 patients who had intra cranial complications of sinusitis between the years, 1964 to 2016 at Poznan, University Hospital, Poland. There were 25 patients with frontal lobe abscess and others cases had other lesions too like epidural, subdural or multiple other brain abscesses. The patients with frontal lobe abscesses had less pronounced neurological symptoms and were more predominantly centered around sinusitis but they had better prognosis. An external sinus frontal approach was used through the eyebrow arch to remove the pathology [pus, granulations or hypertrophied mucosa] from the frontal sinus through the anterior wall and then from the exposed posterior wall the part of the affected bone was removed to find epidural or subdural abscesses or through the same bony dehiscence the neurosurgeon could aspirate the closely lying frontal lobe abscess. In some cases the characteristic features of a sclerotic chalk white appearance on posterior wall of the frontal sinus could be seen, diagnostic for the presence of underlying epidural or subdural empyema. He also agreed that now FESS procedures for removing sinus pathology can also expose the underlying superficial located cerebral abscesses which get spontaneously opened during removal of the bony lesion in vicinity of frontal or ethmoidal sinus and even single drainage can result to a full recovery [12].

Conclusion

Intracranial sinusogenic complications are observed more frequently in young males and may be by an exacerbation in sinus infection during the influenza infection at that time. Streptococci, Staphylococci and anaerobic bacteria are the most frequently encountered pathogens. CT and MRI are the most reliable and the least invasive methods for diagnosing and monitoring intracranial complications [neuronavigation] more so when small abscesses are treated with broad spectrum antibiotics. Usually, in cases where frontal lobe abscess is seen as a complication of frontal sinusitis, a frontal bone craniotomy is done simultaneously along with a FESS procedure to remove the pathologies from frontal sinuses and frontal lobe. When frontal sinusitis results in posterior wall osteomyelitis, creating a bony dehiscence, then along with FESS an open external frontal sinostomy can be done to expose and curette the infected posterior wall of the sinus bone and then through the bony dehiscence, the frontal lobe empyema can be aspirated and drained by a neurosurgeon, avoiding the need for a frontal bone craniotomy. This uncommon technique was utilized in the presented case demonstrating a feasibility of draining a closely situated Frontal lobe brain abscess through the dehiscence in posterior wall of the infected frontal sinus, exposed by external frontal sinostomy. This can be an alternative to frontal craniotomy and also due to a close proximity, the drain produces the least intracerebral tissue damage.

Disclaimer

There is no financial burden on any individual or institution, no conflict of interest and consent was taken for this case report's publication. Our sincere thanks to the director and CEO of the institution, GPHC, Georgetown, for giving permission to use the records and chart of the patient, for this study.

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