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Original Research Paper

Neurosurgery

POST COVID INTRACRANIAL ABSCESS

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ABSTRACT Viral infections have detrimental impacts on neurological functions, and even to cause severe neurological damage. Very recently, coronaviruses (CoV), has effected the lives of millions of people around the globe and especially severe acute respiratory syndrome CoV 2 (SARS-CoV-2), exhibit neurotropic properties and may also cause neurological diseases . In this article we review the complications of COVID effected patients who developed Intracranial Abcess and required neurosurgical Intervention. Brain abscess is defined as a focal intracranial infection that is initiated as an area of cerebritis and evolves into a collection of pus surrounded by a vascularized capsule. Given their location,the approach to brain abscesses often presents diagnostic and therapeutic challenges. The following article reviews a total of 154 post covid ICSOL patients treated in the Department of Neurosurgery at GANDHI MEDICAL COLLEGE AND HOSPITAL in the year 2022.

KEYWORDS :

INTRODUCTION

In December 2019, Corona Virus Disease 2019 (COVID-19) epidemic emerged in Wuhan, China, causing global attentions . The virus is known as especially severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It was recently documented that, in addition to systemic and respiratory symptoms,more than one fourth of patients with COVID-19 develop neurological symptoms, including headache, disturbed consciousness, and paresthesia. Severely affected patients are more likely to develop neurological symptoms than patients who have mild or moderate disease. Additionally, autopsy reports have revealed brain tissue oedema and partial neuronal degeneration in deceased patients. Furthermore, on March 4, 2020, Beijing Ditan Hospital reported for the first time a case of viral encephalitis caused by a novel coronavirus (CoV) attacking the central nervous system (CNS). The researchers confirmed the presence of SARS-CoV-2 in the cerebrospinal fluid by genome sequencing. It illustrated that COVID-19 has potential to cause nervous system damage.

Decreased immunity following COVID-19 and pre-existing diabetes along with denovo diabetes has led to development of various complications which include Rhino-Orbito-Cerebral Mucor mycosis. Rhino-orbital-cerebral mucormycosis is most commonly caused by R. oryzae [1]. Rhizopus organisms have an enzyme, ketone reductase, which allows them to thrive in high glucose, acidic conditions. Serum from healthy individuals inhibits growth of Rhizopus, whereas serum from individuals in diabetic ketoacidosis stimulates growth [2] .Rhino-orbital-cerebral Mucor mycosis are acquired by the inhalation of spores. In healthy individuals, cilia transport these spores to the pharynx and they are cleared through the gastrointestinal tract. In susceptible individuals, infection usually begins in the nasal turbinates or the alveoli [3] .The agents of mucormycosis are angioinvasive thus infarction of infected tissues is a hallmark of invasive disease [4] .There have been case reports of mucormycosis in patients diagnosed with COVID-19, but the relationship of these two infections is unclear. Some of the infections of mucormycosis were diagnosed several days to a couple weeks after being admitted for COVID-19, and it seems reasonable to assume that the mucormycosis was a secondary infection arising in a critically-ill patient on steroids.

MATERIALS AND METHODS

All the patients with an ICSOL in MRI/CT brain, who had a history of covid 19 infection were included in the study. Patients demographic data, Covid status and recovery, usage of steroids during covid treatment, Diabetic history and Presenting complaints and Pre-FESS/Post-FESS status was collected. After imaging, if a single or multiple ring-enhancing lesions are found of size more than 2.5 cm excision of the abscess was done. Post operative tissue biopsy was sent for histological examination, culture sensitivity & staining. Patients with an abscess size of less than 2.5 cm were treated with lipophilic amphotericin B and serial contrast CTs were done to document the reduction of size of the abscess.

Clinical Presentation:

CNS infections caused by the Mucorales group are among the most fulminant infections known. Diabetes mellitus, usually associated with acidosis, is the most common predisposing condition (≈70% of cases), but disease may also be seen in patients with acidemia from profound systemic illness (e.g., sepsis, severe dehydration, severe diarrhea, chronic kidney disease), hematologic neoplasms, renal transplantation, injection drug use, and use of deferoxamine.[5] Over the last two years, this pathogen has also emerged as an important cause of CNS disease in post covid effected patients who have undergone immunosuppressive therapy during the course of the disease and who had DM developed denovo or had a history of DM.

Patients with rhinocerebral mucormycosis initially have symptoms referable to the eyes or sinuses and complaints of headache, facial pain, diplopia, lacrimation, and nasal stuffiness or epistaxis.[6,7] With continued infection and spread to contiguous structures, necrotic lesions appear in the turbinates', nose, paranasal skin, or hard palate; chemosis, proptosis, and external ophthalmoplegia may also occur. Cranial nerve involvement is common, and blindness may occur as a result of invasion of the cavernous sinus, ophthalmic artery, and orbit. Because the organism has a proclivity for blood vessel invasion, thrombosis is a striking feature of the disease. Far-advanced disease is suggested by focal deficits such as hemiparesis, seizures, and monocular blindness. In particular, mucormycosis of the ethmoid sinuses may involve all structures (i.e., orbit and eye, bone, and brain tissue) along its invasive path and carries a high risk of cavernous sinus thrombosis.[8,9] In more than half of patients with the nonrhinocerebal form, fever, headache, and focal neurological deficits are present

Initial symptoms

- Headache
- Fever
- Focal neurological deficits
- Altered mental status

- Seizures
- Nausea
- Vomiting
- Nuchal rigidity and pappilaedema

Diagnosis

Magnetic resonance imaging (MRI) is the diagnostic neuroimaging procedure of choice in patients with brain abscess, it is more sensitive than computed tomography (CT) and offers significant advantages in the early detection of cerebritis, On T1-weighted images, the abscess capsule often appears as a discrete rim that is isointense to mildly hyperintense; administration of gadolinium– diethy lenetriaminepentaacetic acid helps clearly differentiate the central abscess, surrounding enhancing rim, and cerebral edema. On T2-weighted images, the zone of edema that surrounds the abscess demonstrates marked high signal intensity in which the capsule appears as an ill-defined hypointense rim at the margin of the abscess. On diffusion-weighted images, restricted diffusion (bright signal) may be seen and may distinguish abscesses from necrotic neoplasms.

Proton MR spectroscopy is another diagnostic modality that may assist in differentiating between malignant tumors and cerebral abscesses; when combined with diffusion weighted imaging, MR spectroscopy can significantly increase the diagnostic accuracy of conventional MRI.The combined use of proton MR spectroscopy,diffusion-weighted imaging and diffusion tensor imaging has been shown to increase the specificity of diagnosis of the ring enhancing lessions. Characteristic changes may be seen on MRI in patients with rhinocerebral mucormycosis, including sinus opacification, erosion of bone, and obliteration of deep fascial planes; cavernous sinus thrombosis may also be apparent. The lack of contrast enhancement in patients with mucormycosis is a poor prognostic sign because it indicates failure of host defense mechanisms to control the offending agent.

Management

The initial approach to management of a patient with a suspected brain abscess is a multidisciplinary one that involves a radiologist, neurosurgeon, and ENT surgeon. After neuroimaging, if single or multiple ring-enhancing lesions are found, prudent management involves either aspiration or excision of lesions larger than 2.5 cm in diameter, depending on brain location, For abscesses in the early cerebritis stage or if all lesions are 2.5 cm or less in diameter,the largest lesion should be aspirated by means of stereotactic tech- nique for definitive diagnosis and identification of the organism. Although abscess size greater than 2.5 cm has been recommended as an indicator for neurosurgical intervention,[10] data from comparative studies are lacking, and this size cannot be regarded as a definitive indication for aspiration. For patients in whom abscesses cause brain shift leading to brain herniation, neurosurgical intervention may be indicated irrespective of abscess size. Furthermore, drainage should be considered if an abscess is abutting the ventricular system, to prevent abscess rupture and resulting ventriculitis.

After aspiration of abscess material and submission of specimens for special stains, histopathologic examination, and culture, empirical antimicrobial therapy should be initiated. Because anti microbial therapy before aspiration may reduce the yield of bacterial cultures, it is reasonable to postpone initiation of anti- microbial therapy until after neurosurgery has been performed.Delaying antimicrobial therapy should be considered only in clinically stable patients and, therefore, every effort should be made to perform surgery in an expedited manner.

Patients with fungal brain abscess, especially those who are immunocompromised, have a high mortality rate despite combined medical and surgical therapy. Especially in those with mold infections of the CNS, the approach to management must include early diagnosis, administration of antifungal therapy, neurosurgical assessment and intervention, and management of immunologic impairment.

Patients with CNS mucormycosis should be treated with amphotericin B deoxycholate or a lipid formulation of amphotericin B , correction of the underlying metabolic derangements (i.e., metabolic acidosis and hyperglycemia) and aggressive surgical débridement are also critical to successful therapy. Some data have suggested that the lipid formulations of amphotericin B result in higher recovery rates than amphotericin B deoxycholate in patients with mucormycosis and hematologic diseases or solid organ transplantation, leading to a recommendation for use of a lipid formulation, usually liposomal amphotericin B, as first-line therapy.[11] Because the etiologic agents of mucormycosis invade blood vessels, tissue infarction occurs and impairs the delivery of antifungal agents to the site of infection; this development often leaves surgery as the only modality that may effectively eliminate the infecting microorganism. In the patient whose abscess is not responding to or who is intolerant of an amphotericin B formulation, posaconazole can be used as salvage therapy this agent can also be used as follow-up therapy in the patient whose abscess has already responded to an amphotericin B–based therapy, provided the patient is eating well enough to absorb the antifungal agent.[8] Hyperbaric oxygen therapy, granulocyte-macrophage colony-stimulating factor, and interferon-γ have been suggested as adjunctive treatments, but all require further study to assess their efficacy.[8]

In patients with mucor infections reversal of immune suppression is essential for successful outcome,if reversal of immune suppression is not feasible, consideration should be given to minimization of immunosuppressive therapy.

RESULTS

Total of 69 patients who had an abscess size of more than 2.5 cms on imaging were operated, the rest of the patients in whom the abscess size was less than 2.5 cms were treated conservatively with lipophilic ampho B/posacanozole in the Department of Neurosurgery, Gandhi hospital secunderabad. All the reported patients recovered from COVID-19 infection.

- Mean age of presentation was 42 years
- All the patients had history of usage of steroids
- All patients presented with pansinusitis and orbital involvement
- Biopsies of 51 patients showed the presence of mucormycosis,18 patients showed non-specific growth on culture.
- Recurrence rate was 10.5%
- Mortality rate was 26%

Incidence And Risk Factors

The probable infecting pathogen in patients with brain abscess depends on the pathogenesis of the infection and the presence of various predisposing conditions. The most common bacterial causes are streptococci (aerobic, anaerobic, and microaerophilic), which are isolated in up to 70% of cases. Multiple organisms are cultured in 14% to 28% of those patients with positive culture results. The incidence of negative culture results has ranged from 0% to 43%; previous use of antimicrobial therapy may account for such results. Brain abscess caused by Nocardia species may occur as part of a disseminated infection in patients with cutaneous or pulmonary disease; most have defects in cell-mediated immunity such as corticosteroid therapy, organ transplantation, human immunodeficiency virus (HIV) infection, or neoplasia. Mycobacterium tuberculosis has

increasingly been observed to cause brain abscess, with cases reported in patients with HIV infection and solid organ transplantation, although tuberculous brain abscesses can be seen in both immunocompromised and immunocompetent patients.

The incidence of fungal brain abscess has been rising as a result of the increased use of corticosteroid therapy, broad-spectrum antimicrobial therapy, and in the present pandemic era there has been an uprise in fungal abcess in post covid infected patients. CNS infections caused by the Mucorales group are among the most fulminant infections known. Diabetes mellitus, usually asso- ciated with acidosis, is the most common predisposing condition (≈70% of cases), but disease may also be seen in patients with acidemia from profound systemic illness (e.g., sepsis, severe dehy- dration, severe diarrhea, chronic kidney disease), hematologic neoplasms, renal transplantation, injection drug use, and use of deferoxamine.[1,2]

Over the last two decades, this pathogen has also emerged as an important cause of CNS disease in recipients of solid organ and hematopoietic stem cell transplantation.[3] CNS disease results from direct extension from the rhinocerebral form, after open head trauma, or after hematogenous dissemination.Bilateral involvement of the basal ganglia has been reported in injection drug users; Rhizopus arrhizus is the most common isolate.[4]

Age And Sex	Diagnosis	Covid Status	Comorbidities And Duration	Use Of Steroids And Duration	Surgery	Tissue Biopsy	Post Operative Course
48/M	Left Frontal Abcess	Post Covid 2 Mon	Dm Since 3 Yrs	+ For 2 Weeks	Lt Frontal Craniotomy + Excission Of Abcess + Fess		Gcs 15/15
35/M	Right Temporal Abcess	Post Covid 3 Mon	Dm Since 3 Yrs	+ For 1 Week	Rt Pterional Craniotomy + Excission Of Abcess + Fess		Gcs E3v2m6
48/M	Right Frontal Abcess	Post Covid 1 Mon	Dm Since 5 Yrs Htn Since 2 Yrs	+ For 2 Week	Rt Frontal Craniotomy + Fess		GCS 15/15
55/F	Bi Frontal Abcess	Post Covid 2 Mon	Dm Since 7 Yrs	+ For 10 Days	Bi Coronal Craniotomy + Excission Of Abcess + Fess		GCS 15/15
65/M	Bifrontal Abcess	Post Covid 15 Day	Dm Detected Denovo	+ For 10 Days	Bi Coronal Craniotomy + Excission Of Abcess + Fess		GCS 15/15
45/M	Left Temporal Abcess	Post Covid 2 Moths	Dm Since 2 Yrs	+ For 2 Weeks	Lt Pterional Craniotomy + Excission Of Abcess + Fess		GCS E2V2M5
60/M	Left Temporal Abcess	Post Covid 1 Mon	Dm Denovo	+ For 1 Mon	Lt Pterional Craniotomy + Excission Of Abcess + Maxillo-orbitectomy		GCS E1VTM1
55/M	Lt Temporal Abscess	Post Covid 1 Month	dm since 3 yrs	+ For 2 Months	Lt Pterional Craniotomy		E4V5M6
35/M	Rt Frontal Abscess	Post Covid 15 Days	Dm Denovo	+ For 2 Moths	Rt Frontal Craniotomy And Excission		E2VTM4
40/M	Rt Temporal Abcess	Post Covid 2 Months	Dm Since 5 Yrs	+ For 1 Month	Rt Pterional Craniotomy		E4V5M6

Pathogenesis

Organisms can reach CNS through spread from a contiguous sourse of infection(25 to 50%),hematogenous dissemination (20% to 35% of cases), or trauma.Brain abscess is cryptogenic in about 10% to 35% of patients. Sources of a contiguous focus of infection include the middle ear, mastoid cells, and paranasal sinuses. Brain abscess that results from otitis media usually localizes to the temporal lobe or cerebellum; in one review, 54% were in the temporal lobe, 44% in the cerebellum, and 2% in both locations.In patients with brain abscess secondary to paranasal sinusitis, the frontal lobe is the predominant site. When the abscess is a complication of sphenoid sinusitis, the temporal lobe or sella turcica is usually involved. Dental infections, particularly of the molar teeth, can lead to brain abscess[5,6];these often occur in the frontal lobe, but temporal lobe extension has been reported.

ETIOLOGY

In recent years, the incidence of fungal brain abscess has been rising as a result of the increased use of corticosteroid therapy, broad-spectrum antimicrobial therapy, and immunosuppressive agents.[7-10] Candida species have been the most prevalent fungi but are often not discovered until autopsy; these fungi cause microabscesses, macroabscesses, noncaseating granulomas, and diffuse glial nodules. Risk factors for candidal brain abscess include the use of broad-spectrum antimicrobial agents, corticosteroids, and hyperalimentation; premature birth; malignancy neutropenia; chronic granulomatous disease; diabetes mellitus; thermal injury; and the presence of a central venous catheter.

CNS infections caused by the Mucorales group are among the most fulminant infections known. Diabetes mellitus, usually associated with acidosis, is the most common predisposing condition (≈70% of cases), but disease may also be seen in

patients with acidemia from profound systemic illness (e.g., sepsis, severe dehydration, severe diarrhea, chronic kidney disease), hematologic neoplasms, renal transplantation, injection drug use, and use of deferoxamine.[7,11] Over the last two years, this pathogen has also emerged as an important cause of CNS disease in post covid effected patients who have undergone immunosuppressive therapy during the course of the disease and who had DM developed denovo or had a history of DM.CNS disease results from direct extension from the Paranasal air sinuses.

CONCLUSION

The incidence of Mucor IC brain abscess in post covid effected patients is rising,due to the liberal use of corticosteroids, existing co morbidities,and the need for oxygen supplementation during covid course.Aggressive Neurosurgical intervention is necessary for debulking of the abscess and treatment with Liposomal Amphotericin-B followed by posacanozole have proven to be the treatment of choice for mucormycosis IC abscess.We have operated a total of 22 cases so far in the month of June 2021,

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