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Overview of Coronavirus Illness with Diabetic Ketoacidosis In 2019

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Abstract

Background: A uncommon, potentially fatal fungal illness, mucormycosis, affects immunocompromised hosts. The most typical way that diabetes mellitus manifests is with a rhino-orbital-cerebral infection. A rebound of mucormycosis cases during the second wave of the pandemic, where poorly controlled diabetes mellitus was the most important risk factor in the affected population, leading to the discovery of an association with coronavirus illness 2019. The prognosis for rhino-orbital-cerebral mucormycosis is poor, and it has a high fatality rate. In this article, we present a case of newly diagnosed diabetes mellitus complicated by concurrent coronavirus disease 2019, diabetic ketoacidosis, and rhinocerebral mucormycosis at presentation, describe the diagnostic and therapeutic challenges, and go over the interventions that ultimately produced a positive clinical response.

Present a case: We describe the case of a 13-year-old African American female patient who was previously healthy, had recently been diagnosed with diabetes mellitus, and was also infected with the coronavirus 2 that causes severe acute respiratory syndrome. The disease course was further complicated by rhinocerebral mucormycosis. She was diagnosed with diabetic ketoacidosis and warned about cerebral edoema since she had a fever, abnormal mental status, and Kussmaul respirations when she first appeared. Her ongoing fevers and chronically disturbed mental status despite the treatment of her metabolic abnormalities raised suspicions of infectious cerebritis. This prompted assessment with serial head imaging, lumbar puncture, and start of broad empiric antibiotic course due to worry for infectious cerebritis. The diagnosis of rhinocerebral mucormycosis was ultimately validated by head imaging, blood metagenomics testing, and the detection of fungal deoxyribonucleic acid. The patient's condition demanded frontal lobe surgery, rigorous antifungal medication, and adjustment of the antimicrobial regimen due to electrolyte imbalances and alterations in the EKG. The patient was sent from the hospital in stable condition to an inpatient rehabilitation service for reconditioning following a lengthy hospital stay, despite these difficulties and the high fatality rate.

Conclusion: In order to start antifungal therapy and perform surgical debridement in a timely manner, it was crucial to have a high index of suspicion and early diagnosis of rhinocerebral mucormycosis.

Keywords: Antifungal therapy; Coronavirus; Antibiotic

Introduction

A uncommon, potentially fatal infection known as mucormycosis is brought on by fungi from the order Mucorales. Rhizopus is the genus that has been most closely associated with human disease among the mucorales, which are found throughout nature on decaying plants and soil. Mucormycosis presents a variety of clinical manifestations, including pulmonary, cutaneous, disseminated, and rhino-orbital-cerebral. The hyphae of the fungus invade the host's vasculature, causing tissue infarction and [1-4] necrosis, which are the hallmarks of the disease. The risk factors for mucormycosis include diabetes mellitus, phagocyte malfunction (prolonged neutropenia or use of glucocorticoids), and iron overload. Mucormycosis most frequently affects immune-compromised hosts. Poorly controlled diabetes mellitus was the biggest risk factor in India, whereas haematological malignancies and organ transplant recipients were more frequently reported in the rest of the world. Adult cases of diabetic ketoacidosis have reportedly increased during the COVID-19 pandemic. Patients with both diabetes and non-diabetes were found to be in ketosis at presentation in a retrospective cohort analysis of people hospitalised with COVID-19. According to the study, acute COVID-19 infection causes ketosis, which may lead to diabetic ketoacidosis in diabetic patients. Uncontrolled hyperglycemia, immunological dysregulation (caused directly or indirectly by COVID-19 infection), and decreased phagocyte function related to steroid use are some of the postulated causes for COVID-19-associated mucormycosis.

Materials and Method

A 13-year-old African American female with a body mass index of 19.2 kg/m2 and a percentile age and sex of 55.99% went to the emergency room with the main complaints of altered mental status and respiratory trouble. Her SARS-CoV-2 positivity was discovered at an urgent care facility after she had been experiencing headaches and a fever for one day prior to the onset of symptoms. She requested a second opinion at the emergency room the morning of her presentation since her symptoms had progressed to include confusion, heavy breathing, and chest pain. Disorientation, aggressive conduct without a focal neurologic deficit, tachycardia, Kussmaul breathing, dry mucous membranes, and diffuse stomach [5-10] discomfort were pertinent examination findings at the time of presentation. White blood cell count (22.3 103/mcL), anion-gap metabolic acidosis (pH 6.92, pCO2 5 torr, base deficit 28), and hyperglycemia (668 mg/dL) were all detected in the lab. Ketoneuria and glucosuria were significant findings in the urine. Physical examination and lab results were in line with recently identified diabetes mellitus (haemoglobin A1C > 16%) worsened by diabetic ketoacidosis (DKA), probably brought on by acute COVID-19 infection, with characteristics potentially related to cerebral edoema. She received a bolus of 3% hypertonic saline (HTS) and was started on

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continuous insulin infusion (0.1 units/kg/h). She was then admitted to the paediatric intensive care unit (PICU) for continued therapy.

Discussion and Results

The institution's procedure for treating DKA called for intravenous fluids, continuous insulin infusion, and meticulous electrolyte monitoring. She had two more HTS boluses because to a prolonged change in her mental state shortly after arrival, and a head computed tomography (CT) scan was performed, which was normal. Her mentation remained impaired despite these therapies and the correction of metabolic abnormalities. A brain magnetic resonance imaging (MRI) scan performed on day two of hospitalisation revealed aberrant enhancement in the frontal lobe that rose from the olfactory floor upward. Dehiscence of the planum sphenoidale and involvement of the left nasal cavity close to the superior turbinate were other significant findings. These findings raised concerns for an infected cerebritis with a potential for developing phlegmon/ intracranial abscess. These results were alarming for an invasive sinusitis with intracranial extension in the clinical setting of DKA. On day 2, a lumbar puncture (LP) was conducted, and the results showed pleocytosis of the cerebrospinal fluid (CSF) with a neutrophilic preponderance and a negative meningitis encephalitis panel. Due to the small sample amount at the time, CSF cultures were not obtained. Given the potential for invasive fungal disease, an infectious diseases specialist was consulted who suggested an empiric antibiotic course of ceftriaxone, metronidazole, and liposomal amphotericin B. Steroids and antivirals were postponed since the patient did not match the requirements for the acute COVID-19 infection treatment protocol. On the third day after being admitted, a sinus CT scan showed a potential bone defect as well as minor opacification of the superior maeti, maxillary ostium, medial, and posterior ethmoid air cells. Endoscopic nasal examination by an otorhinolaryngology (ENT) surgeon revealed friable tissue without signs of necrosis. Biopsies were not taken during the awake examination due to the patient's low tolerance level. The interval advancement of intracranial pathology with mass effect and cerebral edoema characteristic of infectious cerebritis was visible on day 4 after admission on a repeat head CT. In order to help with the diagnosis after a second LP failed, blood metagenomics testing (Karius test, Redwood City, CA) was acquired on day 5. Despite being treated with broad-spectrum antibiotics, she nevertheless experienced regular fevers. Blood cultures taken at the time of the initial presentation were still negative, and a check for endocarditis as a possible cause of the fever was inconclusive. Posaconazole was added to the antimicrobial treatment on day seven of admission while waiting for the results of the Karius test because invasive fungal disease was the differential diagnosis that worried the patient the most. On the ninth day after admission, the results surfaced, revealing genetic material from the fungus Rhizopus delemar. Rhinocerebral mucormycosis was determined to be the cause of the increasing intracranial disease in the presence of a positive Karius test. Treatment with liposomal amphotericin B and posaconazole was continued at that time, and vancomycin, ceftriaxone, and metronidazole were stopped. The decision to undertake emergency surgical debridement was made after repeat imaging on day 10 revealed disease progression with severe midline shift while on maximal antifungal medication. The patient had a sphenoidotomy with debridement and a frontal craniotomy with drainage of a fungus abscess. Significant intraoperative findings included necrotizing cerebritis and invasive fungal infection. Pathology showed non-septate wide hyphae, dispersed large cells, and the formation of micro-abscesses; tissue culture isolated Rhizopus species. Isavuconazole was substituted for posaconazole on day 13 as a result of the extended QTc interval discovered on the surveillance electrocardiogram (EKG). ENT performed nasal irrigations with amphotericin as an additional kind of treatment. The patient had left-sided hemiparesis, central diabetes insipidus, and chronic changes in mental status due to neurological impairments. Weekly head imaging for disease surveillance revealed disease development even with the most aggressive antifungal treatment. Brain MRI results on surgical day 6 (day 16 after admission) revealed brainstem involvement and an expansion of the intracranial infection to the opposite hemisphere. No additional neurosurgical intervention was advised in light of these findings. The disease kept progressing, and later imaging revealed a deteriorating midline shift (1.5 cm on postoperative day 15) as well as signs of an early temporal lobe herniation. Amphotericin nephrotoxicity, aspiration pneumonia, and thrombus formation linked with venous catheters necessitating anticoagulant medication further worsened the hospital course. On hospital day 20, nasal amphotericin irrigations were stopped because of significant nosebleeds that occurred during the procedure. The aforementioned problems were treated with supportive care, and the patient received isavuconazole and liposomal amphotericin B as part of maintenance therapy. Due to renal impairment, dosage modifications were done for the antifungals. Despite these difficulties, her clinical condition gradually became better. On hospital day 79, she was moved to an inpatient rehabilitation centre for ongoing medical supervision and rigorous therapy to improve functional status. The patient was sent home after 104 total days of hospital care and switched to outpatient treatment. At the time of discharge, amphotericin B was stopped, and she is still just receiving isavuconazole. She has made progress in functional domains ten months after her first diagnosis and can now completely ambulate and carry out daily tasks with little help. An invasive fungal disease called mucormycosis is brought on by members of the Mucorales phylum. The Rhizopus genus contains the majority of the species that have been linked to human disease. The Mucorales are widely distributed in nature and rarely infect immunocompetent hosts with illness. The following manifestations of mucorales include rhino-orbital-cerebral, pulmonary, gastrointestinal, cutaneous, and widespread mucormycosis. Mucorales can enter a vulnerable host through inhalation, consumption of contaminated food, or abraded skin. Diabetes mellitus, hematologic cancers, hematopoietic stem cell transplant, solid organ transplant, neutropenia, usage of glucocorticoids, and iron excess are all risk factors for the condition. On day nine after initial presentation, the diagnosis was made, and despite receiving the most aggressive antifungal treatment and surgical debridement, our patient made progress. Surgical debridement and liposomal amphotericin B are the mainstays of treatment. Posaconazole and isavuconazole, adjunctive azole antifungals, are used as salvage therapy or as a component of a combination antifungal regimen. The registries came to the conclusion that combining surgery and antifungal medication improves results. When possible, removing risk factors that predispose to disease and quickly correcting metabolic abnormalities are advantageous for delaying the advancement of the condition.

Conclusion

Despite being a risk factor for COVID-19-associated mucormycosis, glucocorticoids were not a factor in how quickly our patient's illness spread because she did not receive steroid treatment for her COVID-19 infection. According to the patient's symptoms and a review of the literature, the COVID-19 infection may have increased the patient's preexisting risk factors for developing this severe infection (long-term hyperglycemia, ketoacidosis) through immune dysregulation and the potential precipitation of ketoacidosis. Early diagnosis, treatment start, and surgical debridement are essential for stopping disease progression

and lowering mortality. A high index of suspicion is required for an early diagnosis and course of treatment because to the uncommon occurrence and frequently fulminant progression.

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Declaration of conflicting interests

No potential conflicts of interest were disclosed by the author(s) with regard to the research, writing, or publication of this paper.

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