

Review Article

Anesthetic Management of COVID-19 Associated Mucormycosis: A Narrative Review

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Abstract

Severe COVID-19 disease is currently being managed with glucocorticoids. As a result, there are increasing reports of COVID-19 associated mucormycosis. (CAM) Patients with diabetes mellitus, organ transplant recipients, and immune-compromised patients due to cancer chemotherapy or HIV and AIDS are at high risk of developing CAM. Pharmacotherapy with antifungal agents like Amphotericin B and surgery are the main treatment options. In this narrative review, we will discuss the challenges and anesthetic concerns while managing CAM.

Keywords: COVID-19, mucormycosis, Rhino-Orbito-Cerebral Mucormycosis, Anesthetic concerns, Airway, Difficult Airway, Amphotericin B

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Introduction

More than three million people have lost their lives due to the COVID-19 pandemic. Currently, corticosteroids are the only effective drugs against the disease (1). However, glucocorticoids are like a double-edged sword; In COVID-19, steroids reduce allergic reactions, the suppression of cell-mediated immunity, the accumulation of inflammatory cells, and pro-inflammatory stimuli, all of which reduce inflammation-induced lung injury. However, a weak immune system makes conditions perfect for fungi to flourish. Hence, it is not surprising that there is a rise in cases of COVID-19 associated mucormycosis (CAM). Pharmacotherapy with antifungal agents like Amphotericin B and surgery are the main treatment options. Mucormycosis during COVID-19 poses unique challenges, like the unavailability of anesthetists, personal protective equipment (PPE), antifungal agents. Surgical treatment of Mucormycosis

is an urgent if not emergency procedure as the patient outcome is directly dependent on the timing of the surgery.

Challenges for management of covid-19 associated mucormycosis (CAM): the unique challenges about the management of CAM are – patient profile, availability of operation theater (OT) during the pandemic, and infection prevention.

Surgery for mucormycosis requires general anesthesia and securing the airway with an endotracheal tube (ETT). Mucormycosis is most commonly seen in patients with diabetes mellitus, organ transplant recipients, and in immune-compromised patients either due to cancer chemotherapy or with HIV and AIDS. As steroids are a vital part of the treatment of COVID-19, they also alter glucose homeostasis and hence rise in blood sugar levels, acidosis in case of diabetic ketoacidosis, and low immunity due to steroid caters mucormycosis.

This disease most commonly affects paranasal

sinuses, orbit and can also extend into the cranium, hence called Rhino-orbito-cerebral mucormycosis (ROCM). As the nasal cavity and paranasal sinuses are involved, airway management becomes challenging. Nasal and pharyngeal mucosa become friable and start bleeding; fungal balls and debris can fall into the airway along with friable tissue and blood (2). Some reports also mention supraglottic and glottic inflammation as well as edema (3). Hence, the mucormycosis cases must be managed as an anticipated difficult airway.

Donning and doffing of PPE: it is needless to say that treatment of patients with COVID -19 necessitates separate donning and doffing areas; both the process must be overlooked by an expert infection control nurse, most importantly doffing as this has a higher risk of disease transmission (4, 5).

General precautions: these cases must be operated either in an OT dedicated only for Mucor cases or for COVID-19 cases to avoid the risk of transmission.

Full body cover/gown, an excellent fitting N95 mask, face shield are must – and should be changed if contaminated with patient secretions.

Prompt disinfection of OT is a must with a minimum of 30 minutes gap between two cases (6).

Once the procedure is over, the equipment should be treated with 70% ethanol wipes or 2% glutaraldehyde solution.

Recommendations for safe management for CAM

Pre-operative assessment and preparation: though pre-op assessment is of cornerstone importance, as in any case, the important among them are vitals (mainly oxygen saturation and respiratory rate), hemodynamics, blood investigations, and airway assessment. A thorough airway examination is a must. Mouth opening, modified Mallampati grading, bilateral nasal patency, dentition, upper lip bite test, submandibular space and compliance, neck movement, neck length, presence of beard, and neck thickness must be assessed. These patients usually have facial pain due to ROCM, which might make preoxygenation and bag-mask ventilation (BMV) difficult hence, the BMV procedure must be explained to the patient in detail.

Blood investigation mainly hemoglobin, blood sugar levels over past few days, serum electrolytes, renal parameters including urine output and blood gases (if required), availability of good venous access (due to treatment with Amphotericin B), chest x-ray, chest CT to know the extent of COVID -19 pneumonia and post COVID -19 changes in the lungs, CT PNS to know the extent of the disease and the need for postoperative ventilator requirement on case to case basis.

Informed written high-risk consent should be taken given anticipated difficult airway, and the procedure of bag-mask ventilation should be explained as it can be painful in these patients. If awake fiberoptic bronchoscopy (FOB) is planned, the patient should explain the same, and the airway should be prepared for the same. It is highly advisable to perform oral endoscopy or indirect laryngoscopy to visualize the airway. If the patient is on steroids for a prolonged time or excessive use causing pituitary suppression, then stress dose steroid should be given pre-induction. Blood products should be arranged and should be readily available if necessary.

Bedside PFTs like Sabrasez breath holding time, Sabrasez single breath count, forced expiratory time, bedside pulse oximetry, room air blood gases if required, chest radiograph, and chest CT can provide a rough estimate of pulmonary damage done by COVID -19 disease and available pulmonary reserve.

Patients must be instructed about pulmonary rehabilitation, such as incentive spirometry and deep breathing should be taught to the patient in the peri-operative period to reduce the postoperative pulmonary complications. Pre-operative nebulization with bronchodilators will also be helpful based on case to case basis.

Airway management: as it is an anticipated difficult airway, a senior anesthetist must manage the airway. Difficult airway carts, including smaller size ETTs, video-laryngoscope, and FOB, must be present. A tight face mask seal should be achieved whenever possible, and high-efficiency particulate air (HEPA) filters must be attached to the breathing circuit to avoid aerosolization and risk of contamination. The barrier methods such as clear acrylic or plastic boxes and transparent plastic sheets could be helpful; however,

clinical trials have not evaluated them. These devices have some limitations like difficult positioning of the patient during intubation and extubation, complex visualization of the airway, and reduced airway access in case of loss of airway (7, 8).

Pre-oxygenation: COVID-19 disease process decreased the compliance of the lungs like restrictive lung disease due to fibrosis, leading to reduced functional residual capacity and closing volume and decreased diffusion capacity. Hence, this group of patients desaturates faster; as previously mentioned, they also have anticipated difficult airway – these factors make proper pre-oxygenation mandatory (9). If bag-mask ventilation is difficult due to facial pain, a small dose of opioids can be given to manage the same. Pre-oxygenation can be done with tidal volume breathing for three minutes or eight vital capacity breaths for one minute.

Induction and Maintenance of Anesthesia: the induction agent should be decided based on the patient's hemodynamics and the airway management plan.

Ventilation aids like oral airway should be used

with caution as they might lead to dislodgment of the friable mucosa, bleeding and make the airway more difficult.

In case of anticipated difficulty in the airway or awake-FOB paralytic agents should be administered after the airway is secured.

Tube fixation must be done on the opposite side of the surgery, and the tube must be secured with water-resistant adhesive to avoid tube misplacement during the surgery.

An oral pack should be placed to avoid airway contamination with blood and debris and should be removed without fail post-procedure; the same should be documented.

For maintenance of anesthesia, as in other complex airway cases, desflurane is the agent of choice, then sevoflurane and isoflurane should be avoided, though some reports also suggest antifungal activity of isoflurane in in-vitro studies (10, 11).

Long-acting opioids like morphine are avoided if extubation is planned.

Serum electrolyte abnormalities such as hypokalemia correction must be done during the intraoperative procedure. Surgery should not be postponed due to hypokalemia unless the levels are

Table 1: Anesthetic concerns in COVID-19 related Rhinocerebroorbital mucormycosis.

COVID-19 Related	<ol style="list-style-type: none"> 1. Reduced functional residual capacity 2. Impaired diffusion capacity
Steroid related	<ol style="list-style-type: none"> 1. High blood sugars 2. Low immunity - high risk of infection
Amphotericin B related	<ol style="list-style-type: none"> 1. Hypokalemia 2. Hyperkalemia - if renal functions are deranged 3. Hypomagnesemia 4. Allergic reaction and hypotension 5. Poor vascular access - phlebitis due to the drug. 6. Fever and chills 7. Nausea and vomiting 8. Hypotension 9. Seizures 10. Anemia and Thrombocytopenia 11. Renal dysfunction
Mucormycosis related	<ol style="list-style-type: none"> 1. Facial pain - difficult BMV 2. Difficult intubation 3. Friable tissue in the larynx - laryngeal edema

alarming low.

Balanced salt solutions are the intravenous fluid of choice; in the case of diabetic ketoacidosis, the IV fluids can be chosen according to the status of the patients or according to institute protocol.

Blood sugars should be monitored throughout the surgery, and appropriate management should be initiated. Post-procedure, the patient should be transferred to the intensive care unit (ICU) or high dependency unit (HDU), where continuous monitoring is available and round-the-clock airway management is possible. For postoperative pain relief, paracetamol, tramadol, and short-acting opioids like fentanyl are the first-line drugs; NSAIDs should be avoided as they might worsen the nephrotoxicity Amphotericin B. Table 1 depicts the anesthetic concerns while managing CAM.

Conclusion

Steroid use in COVID -19 patients has increased the risk of invasive fungal infections. Along with challenges faced due to the pandemic, surgical management of mucormycosis has unique anesthetic implications, like anticipated difficult airway, challenges due to altered blood sugar homeostasis, and complications caused by the most effective drug against mucormycosis – Amphotericin B. therefore, clinicians must be aware of serious complications that may arise while managing CAM so that early diagnosis and timely intervention can be taken to improve the patient outcome.

Acknowledgment

None.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

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