

Original Article - Case Study

Bain's circuit as continuous positive airway pressure device in a postoperative COVID-19 associated mucormycosis patient with type-1 respiratory failure: a case report

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ABSTRACT

The surge in coronavirus disease of 2019 (COVID-19) pneumonia cases has brought about a wave of COVID-19 associated mucormycosis, especially in patients with diabetes and those on immunosuppressive drugs. In addition, the antifungal therapy and the residual cardiopulmonary illness bring about an array of challenges in the perioperative period. Most often, such patients are far from optimized and need urgent surgical intervention. Regardless to say, many need some form of respiratory assistance in the postoperative period as well. With the pandemic already throttling the existing resources, such as ventilators and oxygen supply, it may be prudent to use devices from an anesthetist's armamentarium to aid patient's oxygenation and ventilation in the perioperative period. The authors describe one such case using Bain's circuit and a noninvasive ventilation mask to function as a continuous positive airway pressure device.

Keywords

COVID-19, fungi, mucormycosis, anesthesia; artificial respiration.

INTRODUCTION

Mucormycosis is a rare, life-threatening infection caused by a fungus called mucormycetes and has been described in patients with medical conditions where immunity is compromised¹. The coronavirus disease of 2019 (COVID-19) pandemic has unleashed havoc worldwide, and the use of steroids, monoclonal antibodies, and broad-spectrum antibiotics are rampant in the management of COVID-19 patients. Steroid use leads to hyperglycemia and negatively impacts glycemic control, even in diabetic patients. Furthermore, immune dysregulation in COVID-19 is also now well-known². All these factors provide a congenial environment to the opportunist fungus³, and COVID-19 associated mucormycosis is becoming an added challenge in this pandemic⁴. As the patients' lungs are often in a bad condition due to COVID-19, perioperative respiratory failure management remains difficult.

CASE REPORT

A 46-year-old gentleman, weighing 65 kg, was posted for debridement of sino-nasal lesions of COVID-19 associated mucormycosis. The patient

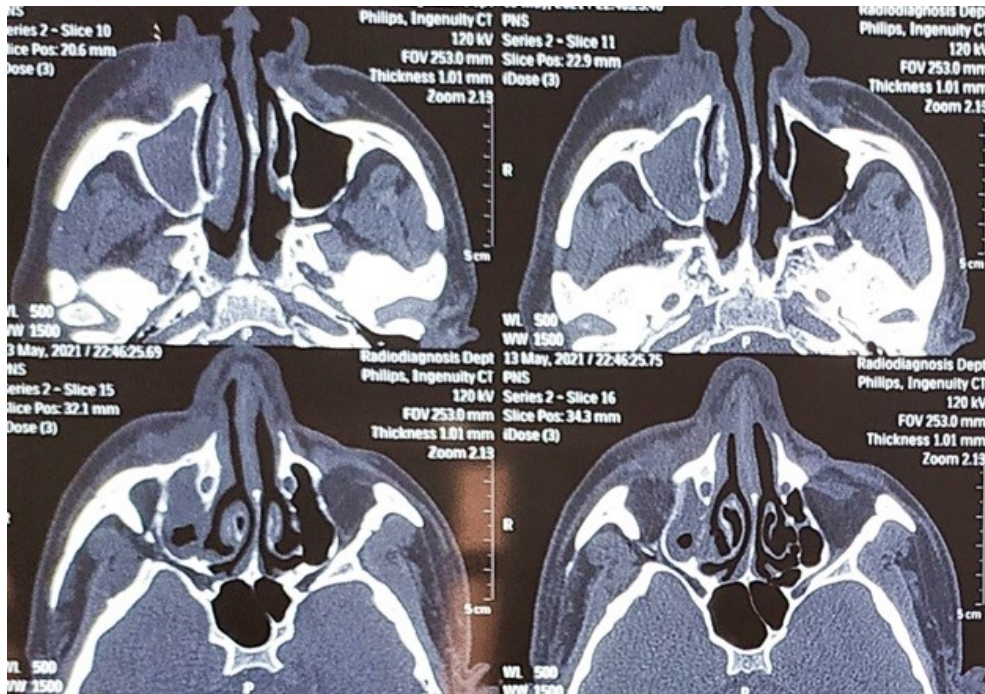


Figure 1. Computed tomography (axial section) of rhino-orbital region showing soft tissue swelling in the infraorbital region, maxillary sinus and nasal cavity of the right side

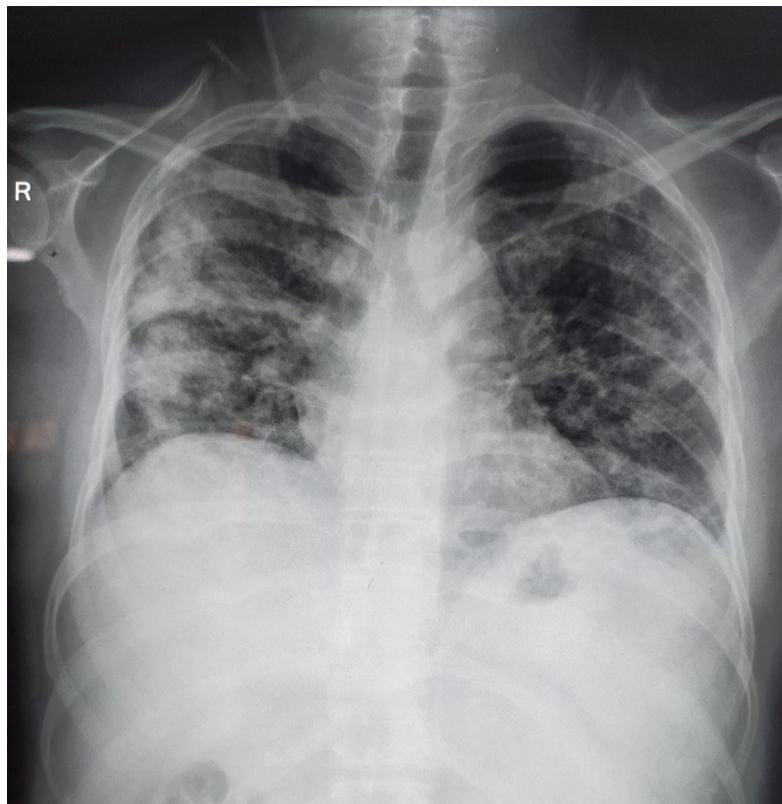


Figure 2. Chest x-ray showing bilateral diffuse, multifocal, nonhomogeneous opacities predominantly over the mid and lower lobe

had fever, cough, breathlessness and was diagnosed with COVID-19 four weeks back. He received low-molecular-weight heparin, remdesivir, methylprednisolone, broad-spectrum antibiotics, and oxygen therapy by non-rebreathing mask. His condition improved, and he tested negative for COVID-19 on the 21st day. However, he subsequently developed swelling and pain over the right infraorbital region, upper jaw, and headache two days before the COVID-19 negative report. The cough and exertional breathlessness persisted throughout. Clinical findings, microbiological study, and computed tomography (Figure 1) confirmed the diagnosis of COVID-19 associated mucormycosis. He is a known case of diabetes for the past two years and was on oral hypoglycemics. During COVID-19 hospitalization, insulin was initiated, and blood sugar was maintained between 150-200 mg/dl. Following the diagnosis of COVID-19 associated mucormycosis, he received the first dose of liposomal amphotericin B. He was conscious, oriented, but anxious, having tachypnoea and a room air saturation of 91%. Crepitations over the right basal lung field were present. Gingival mucosa discoloration, a few loose teeth, pus discharge, right infraorbital swelling, lid edema, and conjunctival congestion were also present. No neurological deficit was noted. His preoperative hemoglobin, platelet counts, serum creatinine, and blood urea were within normal limits, but a mild hypokalemia (K^+ 2.7 mEq/L) was present. Chest X-ray showed bilateral diffuse, multifocal, nonhomogeneous opacities, predominantly over the mid and lower lobe (Figure 2). Preoperative arterial blood gas measurements showed pH 7.49, pCO₂ 27 mmHg, pO₂ 60 mmHg and HCO₃ level of 20 mEq/L.

With informed and written consent, the patient was taken for surgery. The American Society of Anesthesiologists standard monitoring was applied, and the right radial arterial line was secured and transduced. He was premedicated with midazolam injection 1 mg, the general anesthesia was induced with fentanyl injection 100 microgram and propofol injection 100 mg. After confirming bag-mask ventilation, injectable vecuronium 5 mg was used to facilitate tracheal intubation. A 7.5 mm inner diameter (ID) flexometallic tube was used to secure the airway. Balanced low flow anesthesia was maintained with isoflurane in air and 50% oxygen.

The age adjusted minimum alveolar concentration of potent inhalational agent was maintained at 1+/-0.1.. Injection vecuronium as a muscle relaxant, nalbuphine injection 4 mg, and paracetamol 1 gm were administered as analgesic. Intraoperative arterial blood gas measurements showed pH 7.46, pO₂ 111 mmHg, pCO₂ 35 mmHg and HCO₃ level of 22 mEq/L. The surgery lasted for three hours, and the intraoperative course was uneventful. Thus, the inhalational agent was cut-off, and pressure support ventilation mode indicated good efforts. Neostigmine injection 2.5 mg and glycopyrrolate 0.5 mg were used to reverse neuromuscular blockade. He was extubated uneventfully and was put on a face mask 8 L/min. However, despite having a good respiratory pattern and depth, his saturation remained below 94%. Therefore, he was shifted to a post-anesthesia care unit, put on a noninvasive ventilation mask connected to Bain's circuit with an adjustable pressure limiting valve (Figure 3), and maintained a SpO₂ of 99 to 100% with O₂ 8 L/min. His condition improved over the next 12h and arterial blood gas measurements showed pH 7.40, pCO₂ 32 mmHg, pO₂ 110 mmHg and the HCO₃ level of 19 mEq/L. The patient was weaned to face mask and subsequently to room air and maintained SpO₂ of 96-98% without respiratory distress by the next day.

DISCUSSION AND CONCLUSION

Our patient posed a few challenges apart from airway management, perioperative glycemic, and hemodynamics control. While medical management using antifungals is ubiquitous, successful treatment of rhino-cerebral mucormycosis often includes surgical modalities requiring perioperative care. Recent literature recommends liposomal amphotericin B and surgery wherever possible, as the first line and posaconazole as the second line pharmacological agent⁵. On the other hand, these antifungal affect serum K^+ and renal function⁶, impacting anesthesia management and perioperative outcome⁷. Therefore, pre-anesthetic evaluation of such patients should be meticulously performed, and appropriate correctable and optimizing strategies are crucial, especially for the correction of dyselectrolytemia and prevention of further kidney injury.



Figure 3. Showing the application of Bain's circuit as continuous positive airway pressure device in the postoperative period

Over and above dyselectrolytemia, our patient also had a type-1 respiratory failure with terrible lung status due to a recent COVID-19 infection. While it is advised to time the elective surgeries in post-COVID-19 patients^{8,9}, patients with COVID-19 associated mucormycosis cannot wait, and urgent surgery is required. Residual shortness of breath from cardiopulmonary dysfunction also requires special consideration during perioperative management⁹. Furthermore, invasive ventilation increases the risk of ventilator-associated pneumonia. On the other hand, noninvasive positive pressure ventilation after extensive sino-nasal surgery is not without risk. The nostril is usually packed in such patients, and a high-flow nasal cannula in such a scenario is also not feasible. Therefore, we decided to use indigenously adapted Bain's circuit as a continuous positive airway

pressure device where the APL valve of the Bain's circuit was slightly closed to provide approximately 3-5 cm H₂O resistance. It worked for the patient, and the patient maintained both oxygenation and ventilation well (as evidenced from arterial blood gas measurements), and even clinical condition improved over the next 12h.

COVID-19 associated mucormycosis is emerging as another havoc. Most cases are being reported from India¹⁰. Many patients will require perioperative O₂ therapy, including artificial respiratory support. In developing countries where health resources and funds are limited, this modified low-cost aid might be helpful in selected patients.

Conflict of Interest

The authors declare no conflict of interest.

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