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CASE REPORTS

Pituitary tumor resection in a patient with SARS-CoV-2 (COVID-19) infection. A case report and suggested airway management guidelines

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Abstract The 2020 pandemic caused by the novel coronavirus, COVID-19, had its headquarters in China. It causes Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) and presents a broad spectrum of clinical manifestations, ranging from entirely asymptomatic through severe acute respiratory failure and death. Presuming a significant quantity of ventilator-dependent patients, several institutions strategically delayed elective surgeries. Particularly procedures performed involving the nasal mucosa, such as a transsphenoidal approach of the pituitary gland, considering the tremendous level of viral shedding. Nevertheless, critical cases demand expeditious resolution. Those situations are severe pituitary apoplexy, declining consciousness level, or risk of acute visual loss. This case presents a successful urgent perioperative management of a 47 year-old male COVID-19 positive patient who presented to the Emergency Department with a left frontal headache that culminated with diplopia, left eye ptosis, and left visual acuity loss after 5 days. Transsphenoidal hypophysectomy was uneventfully performed, and the patient was discharged from the hospital on postoperative day four. It additionally describes in detail the University of Mississippi Medical Center airway management algorithm for patients infected with the novel coronavirus who need emergent surgical attention.

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PALAVRAS-CHAVE
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Assistência perioperatória de paciente com infecção pelo SARS-CoV-2 (COVID-19) submetido a ressecção de tumor de hipófise urgente. Relato de caso e diretrizes para manejo de via aérea

Resumo A pandemia de 2020, causada pelo novo coronavírus, COVID-19, teve seu epicentro na China. Causa Síndrome Respiratória Aguda Grave pelo Coronavírus 2 (SARS-CoV-2) e apresenta um amplo espectro de manifestações clínicas, que vão desde nenhum sintoma a insuficiência respiratória aguda grave e óbito. Com a expectativa de um número significativo de pacientes dependentes de ventilador, várias instituições estrategicamente adiaram cirurgias eletivas. Esse é o caso principalmente de procedimentos envolvendo a mucosa nasal, como a via transesfenoidal para a hipófise, devido ao nível imenso de disseminação de material viral. Não obstante, casos críticos requerem resolução acelerada. Essas situações são grave apoplexia hipofisária, diminuição do nível de consciência ou risco de perda visual aguda. O presente caso relata o manejo perioperatório bem sucedido de urgência de paciente do sexo masculino de 47 anos de idade com COVID-19 que chegou ao Pronto Socorro com cefaléia frontal à esquerda que culminou com diplopia, ptose do olho esquerdo e perda de acuidade visual à esquerda após 5 dias. A hipofisectomia transesfenoidal ocorreu sem intercorrências e o paciente recebeu alta do hospital no quarto dia do pós-operatório. Adicionalmente, descrevemos em detalhe o algoritmo de manejo de via aérea da *University of Mississippi Medical Center* para pacientes infectados pelo novo coronavírus e que necessitam de atenção cirúrgica de emergência.

Introduction

A global outbreak of the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) caused by the novel coronavirus, COVID-19, had its epicenter in Wuhan City, Hubei Province of China.[1] In this city, from December 31, 2019 through January 3, 2020, 44 patients with pneumonia, at that time of unknown etiology, were detected and reported to the World Health Organization (WHO).[1] In the following weeks, the enveloped non-segmented positive-sense RNA virus belonging to the family Coronaviridae[2] spread to all continents with devastating public health and economic consequences. The most frequent clinical features of the disease are fever, cough, malaise, myalgia, anosmia, and gastrointestinal symptoms.[3]

The spectrum of clinical manifestations are broad, contemplating from asymptomatic through severe acute respiratory failure and death.[3,4] The infection is highly contagious, and even presymptomatic/asymptomatic patients can transmit the virus, principally through respiratory droplets.[5] The viral transmissivity from asymptomatic patients contributes to the high-risk of infection not only for the public in the hospital but also for healthcare workers, which are extremely exposed during the pandemic period. Expecting an extraordinary amount of critical patients depending on mechanical ventilation due to SARS-CoV-2 infection and aiming for an abundance of available intensive care unit beds and equipment, all elective cases were strategically postponed, and only emergency cases should be performed.[6] Especially procedures performed involving the nasal mucosa, nasopharynx, and cribiform plate such as a transsphenoidal approach of the pituitary gland, considering the tremendous level of viral shedding.[7]

In this case report, we would like to share our experience of an urgent pituitary tumor resection in a COVID-19 positive patient with recent visual field deterioration and cranial nerve compression. The objective of this article is also to describe the University of Mississippi Medical Center airway management protocol for surgical procedures in known COVID-19 positive patients. For this reason, it presents a detailed description of pre- and postoperative periods, including our protocols for anesthetic induction, airway instrumentation, patient transportation, and extubation.

Case description

Here, we describe a successful urgent perioperative management of a 47 year-old male patient (175.3 cm; 94.3 kg; BMI = 30.7 $kg.m^{-2}$) with unremarkable past medical history who presented to the Emergency Department (ED) with a left frontal headache that began 5 days before. It was followed by diplopia, left eye ptosis, and left visual acuity loss 48 hours before his first consult. The headache had been constant, not relieved by any medication. He denied either burning, radiation, or throbbing sensation. The patient also stated that the painless ophthalmological symptoms initiated suddenly. The headache was getting worse at that time he requested to visit the ED. The patient stated that three weeks before this event, everyone in prison had muscle aches, possibly associated with the COVID-19 outbreak. Pain management with ibuprofen was unsuccessful. The patient acquainted with no pertinent past surgical history. The vital signs were with normal limits, and a head Computed Tomography (CT) was ordered (Fig. 1a and b). Based on the CT findings, Magnetic Resonance Imaging (MRI) of the pituitary

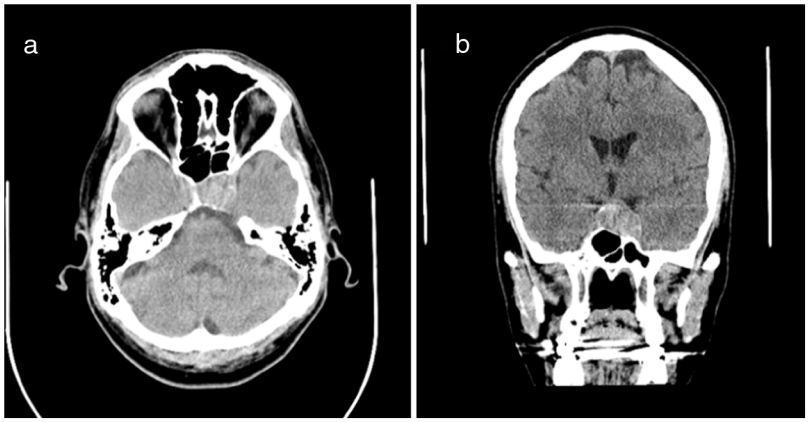

Figure 1 (a and b) Computed tomography without contrast. Axial (a) and coronal (b) slices show predominantly hyperdense sellar mass measuring $1.9 \times 2.8 \times 2.0$ cm eccentric to the left with extension into the suprasellar cistern, impingement on the left optic chiasm, and dehiscence of the bilateral posterior sphenoid sinus walls.

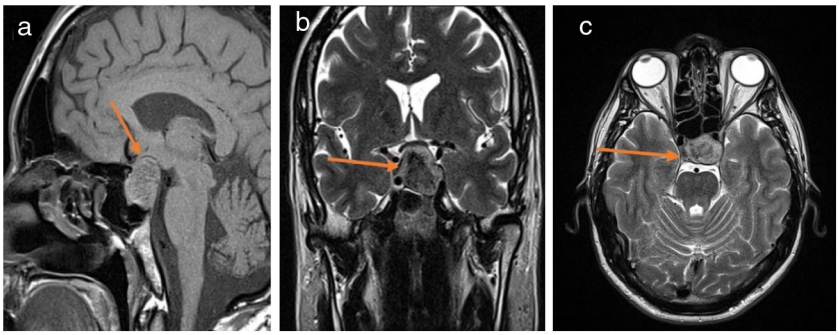

Figure 2 (a–c) Pituitary MRI with and without contrast. (a) Sagittal T1 Sellar mass with obscuration of the pituitary stalk; (b) and (c) coronal and axial T2 – heterogeneous peripherally T2 isointense centrally dark mass with diminished enhancement in the sella turcica extending into the suprasellar cistern with local mass effect. Elevation of the optic chiasm as well as prechiasmatic portion of the left greater than right optic nerve. Findings compatible with pituitary macroadenoma with central hemosiderin deposition suggesting remote hemorrhage.

gland was obtained (Fig. 2a, 2b and 2c). The patient was admitted to the Neurosurgical ward.

Additionally, the SARS-CoV-2 RNA panel by RT-PCR revealed a positive result one day after his admission (day 2). He was transferred to the COVID-19 floor. On Day 3, the patient complained of worsening left visual acuity with no improvement of headache. Based on a possible definitive visual loss, neurosurgery decided to schedule him for an urgent transsphenoidal pituitary tumor resection for the following morning (day 5).

On day 5, the patient was transferred to the main Operating Room (OR) area, straight to the Negative Pressure Induction Room. A plastic drape entirely covered the patient. The standard American Society of Anesthesiologists monitor and neuromuscular blocker monitor were set following by preoxygenation for five minutes with the fraction of inspired oxygen (FiO_2) at 100%. The facial mask is held using both hands intending for perfect sealing and consequently decreasing the rate of external contamination. The inspiratory and expiratory flows have to go through the viral filter. A shoulder roller was in place for better airway axis alignment, increasing tracheal intubation success in the first attempt. His vital signs were within normal limits. Anesthetic induction with a rapid sequence technique was chosen primarily for decreasing the risk of potential aerosolization of the virus from the patient's airway. Medications used were lidocaine 1% (1 $mg.kg^{-1}$), fentanyl (1 $\mu g.kg^{-1}$), propofol (3 $mg.kg^{-1}$), and succinylcholine (1 $mg.kg^{-1}$). Immediately after induction, a stress dose of hydrocortisone 100 mg was given. Uneventful tracheal intubation was performed using a video laryngoscope. Following induction, another intravenous access was obtained, and a radial arterial line established. The patient was transferred from the Negative Pressure Room (NPR) to the Positive Pressure Operating Room (PPOR). An unexceptional transsphenoidal pituitary tumor removal was accomplished, and the patient remained intubated at the end of the case for ICU transport and extubation. The anesthetic maintenance was executed with propofol (80–100 $\mu g.kg^{-1}.min^{-1}$) and remifentanil (0.08–0.12 $\mu g.kg^{-1}.min^{-1}$) infusions and a 0.5 Minimal Alveolar Concentration (MAC) of desflurane. For patient transport to the ICU, dexmedetomidine was started at 0.6 $\mu g.kg^{-1}.h^{-1}$ intending for cough reduction on extubation. Postoperative endocrinology evaluation revealed low morning cortisol level, standard range T4, and no significant urine output. A maintenance hydrocortisone dose of 20 mg in

the morning and 10 mg in the evening was launched due to a central adrenal insufficiency syndrome. The patient was transferred from ICU to the floor the subsequent day. He was discharged from the hospital on postoperative day four without complications.

Discussion

The sellar region approach for pituitary tumor resection by the transsphenoidal endoscopic operation is more commonly practiced than craniotomies.[8] SARS-CoV-2 highly colonizes the nasal mucosa, and due to its exacerbated shedding degree is hugely contagious. The American College of Surgeons recommended that all elective surgeries should be postponed during the COVID-19 pandemic.[9] Nevertheless, emergent hypophysectomy due to severe pituitary apoplexy, declining consciousness level, or risk of acute visual loss could not be delayed.[8] In those circumstances, the transcranial approach should be preferred rather than through the skull base.[10] The decision needs to be made on a case-by-case basis.[8] That combines surgeon preference and comfortability in performing the surgical procedure.

Airway management for patients COVID-19 positive is an immense challenge. For this reason, we decided to share with the scientific community the University of Mississippi Medical Center (UMMC) guidelines for perioperative management of patients infected with SARS-CoV-2. It divides this section into three stages: preoperative care, intraoperative phase, and postoperative period.

Preoperative care

UMMC perioperative guidance airway manipulation for urgent operations on patients with proven or suspected COVID-19 infection is the following:

1. Logistics and personnel: Four people wearing Personal Protective Equipment (PPE) are involved in transporting the patient from the floor/Intensive Care Unit (ICU) to an induction (negative pressure) room in the main operating room area. They are one anesthesiologist, one Certified Registered Nurse Anesthetist (CRNA), Anesthesiology Resident (AR), one Nurse Circulator (NC), and one Anesthesia Technician (AT). The AT carries the code bag and clears the path (opening doors, calls elevators) with help from the circulating nurse. The AT and NC stay 6 feet (2 meters) away and avoid contact with the patient. Intubation, extubation, and recovery are achieved in an NPR, while the surgical procedure is performed in a PPOR.
2. Surgical patient: Formerly in the ICU or ED: the patient is intubated there and then transferred directly to the PPOR. For patients carried from the floor to the main OR, they are first transferred to an NPR where airway instrumentation occurs, and then transferred to the PPOR. The patient's face must be shaved before intubation to prevent a virus's aerosolization during preoxygenation.
3. Preoperative preparation: Assemble all needed supplies in the Negative Pressure Room (induction and extubation), and the PPOR. Verify if the COVID-19 anesthesia supply kit labeled ''Plan A, B, C'' (Tables 1–3), and the ''COVID-19 Surgical Medications'' drug kit stocked in the Omnicell core cabinets are prepared. Acquire controlled substances and all syringes needed for the entire case. Simple facemask and nasal cannula for postoperative oxygen for transport to the floor are available. An extra C-Mac or Glidescope ready for backup. Arrange an area for donning and doffing of PPE and remove all non-essential supplies from the OR. Cabinets and drawers must be closed. A dedicated OR runner is assigned to deliver any other materials to the room.

   Plan C Material for cricothyroidotomy to be performed by the anesthesiologist.

   Other necessary equipment are Ambu bag, Positive End-Expiratory Pressure (PEEP) valve, viral filter, ''Ballard'' closed suction, saline for lavage, disposable stethoscope, Bougie, and flexible connector.
4. Assignment: Allocate the most experienced anesthesia professionals available to perform intubation, if possible. No trainee intubation is allowed (students or junior residents).
5. Avoid: Forced air patient warming system and awake fiberoptic intubation due to the aerosolization of the virus.
6. Before entering the OR: Apply your PPE. It includes N95 mask, footwear, gown, face shield, and gloves (two surgical gloves required for anesthesia providers). For difficult intubation, check if there is a surgeon present that is comfortable with emergency surgical airway placement.

Table 1 Plan A.

ETTs: 6.0, 6.5, 7.0, 7.5, 8.0	Lubricant
C-Mac Stylet/Traditional Stylet	Head strap
1T̈ape	Hemostat
10 mLs Syringe	Clear Drape

ETT, Endotracheal Tube.

Table 2 Plan B.

Intubating LMA	McGrath disposable blades: n° 3, n° 4
LMAs: iGel 4, 5	Laryngoscope handle
Oral airways: 9, 10	Laryngoscope blades: Miller 2, Mac 3, 4

Table 3 Plan C.

Material for cricothyroidotomy to be performed by the anesthesiologist.

Intraoperative phase

No in/out traffic is allowed. The starting team does the complete case. The runner verifies if the PPEs are being worn correctly and delivers needed materials via sub-sterile corridor. Apply Standard ASA monitoring and neuromuscular blocker monitor. Set a shoulder roll to align the airway axis better and increase the success rate of intubation. Place a plastic drape over the patient to decrease the contamination rate (Fig. 3). The patient's bed/stretcher remains in the room the entire time.

Figure 3 Plastic drape over the patient while airway instrumentation to secure airway.

1. Intubation: Preoxygenate the patient for 5 minutes with 100% FiO_2 at 5 L.min^{-1} flow. No PEEP. Ensure Adjustable Pressure Limiting (APL) or pop-off valve is entirely open. Conduct a rapid sequence induction to avoid positive pressure ventilation and potential aerosolization of virus from airways. A high-dose rocuronium (1.2 mg.kg^{-1}) is an option for patients with contraindication to succinylcholine. A videolaryngoscope is used on every patient. High-quality Heat and Moisture Exchanging Filter (HMEF) rated to remove at least 99.97% of airborne particles 0.3 microns or higher is placed in between the facemask and breathing circuit or between facemask and reservoir bag. In the case of a failed intubation, place an Intubating Laryngeal Mask Airway (ILMA) and ventilate with low tidal volume (no more than 6 mL.kg^{-1}) and no PEEP. Determine if the patient needs an additional attempt versus to be woken up or surgical airway instrumentation. ''Ballard'' in-line closed suction® is available in case the patient needs tracheal suctioning. Insert any additional intravenous lines and an arterial line at this time.
2. Disposable equipment used in the OR: Laryngoscope and stylet are discarded in a bucket inside a biohazard bag. The red bag is available in the OR to dispense of all used material that was opened. All other tool kit bags that were not opened are cleaned and re-stocked.

Postoperative period

1. Transport: After the case completion, the patient is transported back to a Negative Pressure Extubation Room, or a ''clean'' transport team carries the patient to the ICU. During the transport of an intubated patient, PPE is required, and ETT always connected to the filter and the Ambu bag or transport ventilator. If the viral filter must be disconnected from the ETT for any reason, it should be clamped to prevent the airway's aerosolization.
2. Extubation: The patient is transferred back to the NPR for extubation. Sugammadex (2, 4 or 16 mg.kg^{-1}, following institution guidelines) is used for every patient receiving rocuronium to prevent failed extubation and possible re-intubation.[11] The goal is > 90% recovery on the quantitative monitor. A 200 mg vial is in the medication bag. If more is needed, ask a runner to retrieve more from Core Omnicell. The NPR serves as a Postoperative Care Unit (PACU) until the patient is ready to be transferred

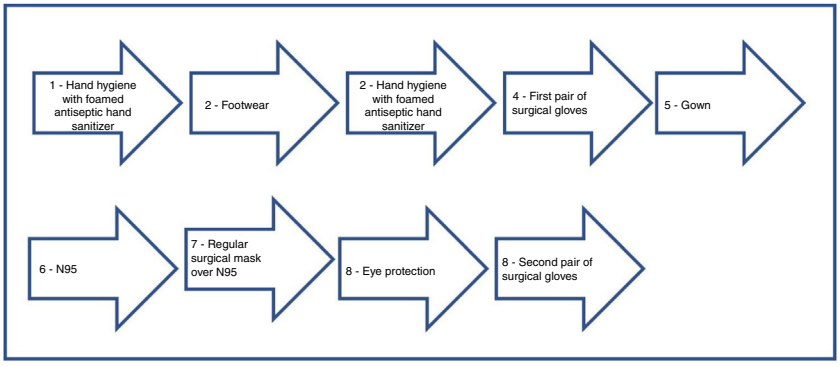

Figure 4 Donning order (UMMC protocol) for COVID-19 positive patients.[13]

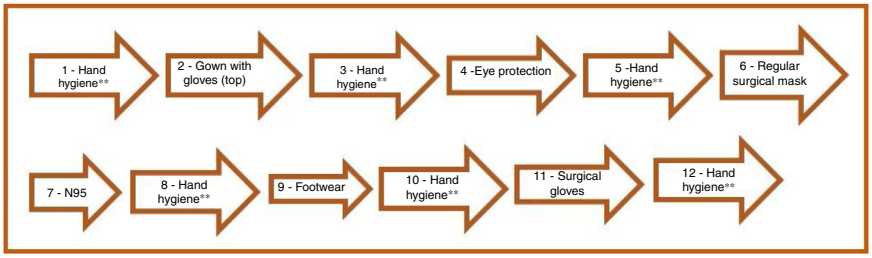

Figure 5 Doffing order (UMMC protocol) for COVID-19 positive patients.[14] Hand hygiene**: Hand hygiene with foamed antiseptic hand sanitizer.

to their original room. All medical personnel involved in the patient care/transport must change scrubs. If the patient is going to be extubated in the ICU, the sedation of choice for transport is dexmedetomidine since it is the most effective medication in reducing either moderate or severe cough following general anesthesia with endotracheal intubation.[12]

3. After leaving the OR: Isolate the OR for one hour to allow air exchange. After that, it is cleaned by Environmental Services. Finally, the OR has Ultraviolet (UV) lights placed after the cleaning conclusion. The turnover time takes approximately two hours. The runner writes all pertinent times on the OR door. The ''Room Ready Checklist'' is signed off by the anesthesiologist.
4. Donning and doffing: Donning (Fig. 4) and doffing (Fig. 5) are crucial points when regarding patients infected with the SARS-CoV-2 virus. These procedures must be done following the institution protocol, and a third person must verify that it has been followed properly.

Conclusion

At this point, it is unknown when an effective treatment or vaccine would oppose the novel coronavirus outbreak. The uncertainties of this new era demand particular attention to patients and staff safety. Among the ambiguities and different opinions that might precede a worldwide algorithm, some points are incredibly relevant. Ideally, the anesthesia team needs to be exhaustively training in the simulation laboratory, empowering airway management skills under those adverse circumstances.[14] By familiarizing with the institution guideline, they are more comfortable and accurate on performing their duties without hurry or delay.[14] We strongly recommend that every institution should have an updated airway management guideline for patients infected with SARS-CoV-2 that applies to their local reality. It is the most effective way to improve patient outcomes and protect the health care workforce.

Conflicts of interest

The authors declare no conflicts of interest.

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