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Management of complicated pediatric rhinosinusitis in the COVID-19 era

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ABSTRACT

With the ongoing development of the COVID-19 pandemic, research continues to emerge regarding the pathophysiology, characteristics, and treatment considerations for patients with COVID-19. No reports have highlighted the specific challenges posed in the management of pediatric patients with COVID-19 who present with complicated rhinosinusitis. In this report, we discuss our preoperative, intraoperative, and postoperative multidisciplinary treatment strategy for these cases and provide two examples of complicated rhinosinusitis cases in COVID-19 patients, treated with two different approaches. Pearls, insights, and a brief review of the literature are discussed.

1. Introduction

Complicated rhinosinusitis is defined as the sequelae of direct extension of acute rhinosinusitis to adjacent structures [1,2]. Sequelae of complicated rhinosinusitis include orbital complications, such as preseptal cellulitis, subperiosteal abscess, orbital cellulitis, orbital abscess, and cavernous sinus thrombosis [1–4]. Intracranial complications also can occur, resulting in meningitis, epidural abscess, subdural abscess, intracerebral abscess, and osteomyelitis of the frontal bone [5]. Viral infections are the most common cause of rhinosinusitis and have been found to be a nidus for bacterial superinfection [6].

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which on March 11, 2020 was declared a worldwide pandemic by the World Health Organization (WHO) known as Coronavirus disease 2019 (COVID-19), has not previously been associated with complicated rhinosinusitis. Since the WHO declaration, there has been evidence reporting high viral loads of SARS-CoV-2 in the sinonasal cavity and nasopharynx [7]. As of July 18, 2020, over 14 million cases of COVID-19 have been reported worldwide with over 600,000 global deaths [8]. In the Unites States (US), COVID-19 cases have continued to demonstrate an upward trend since March 2020, now with over 3.6 million documented cases [8]. Despite vast research being performed to elucidate the pathophysiology, patient characteristics, and treatment considerations, no case of complicated rhinosinusitis in COVID-19 patients to our knowledge has been described in the current otolaryngology literature.

2. Illustrative Case I

An obese 15-year-old African American male with recent travel history presented to an outside emergency department (ED) with a three-day history of headaches, subjective fevers, nasal congestion, diarrhea, nausea, emesis, right periorbital swelling, pain, and blurred vision. Computed tomography (CT) revealed right-sided rhinosinusitis and an epidural collection posterior to the right frontal sinus (Fig. 1). He was transferred to our facility. The patient was febrile, tachycardic, and tachypneic, with a right-sided orbital cellulitis on exam. Nasal endoscopy revealed right middle meatal purulence and mucosal inflammation. He was neurologically intact. Table 1 highlights his laboratory values. SARS-CoV-2 ribonucleic acid (RNA) testing was positive.

Multidisciplinary management approach with otolaryngology, ophthalmology, neurosurgery, infectious disease, and pediatrics was initiated. Treatment consisted of vancomycin and ceftriaxone, tobramycin eye drops, nasal saline irrigation, intranasal oxymetazoline and fluticasone, and prophylactic levitiracetam. After no clinical improvement for 24 h, magnetic resonance imaging (MRI) revealed persistent rhinosinusitis, epidural collection, and superior ophthalmic vein...
thrombosis (SOVT) (Fig. 2).

On hospitalization day 3, he developed worsening chemosis, prop- 
tosis, and visual acuity. He was taken to the operating room (OR) for 
endoscopic right maxillary antrostomy, total ethmoidectomy, and 
frontal sinusotomy (Fig. 3). Only non-powered instrumentation was 
utilized. Intraoperative cultures grew coagulase-negative Staphylo- 
coccus. Postoperatively, he developed hypoxia to 89% on room air. 
Chest x-ray revealed bilateral, patchy opacities. He was also started on 
metronidazole, hydroxychloroquine, enoxaparin, zinc, vitamin C, and 
thiamine. He necessitated transfer to the pediatric intensive care unit 
(PICU) for bilevel positive airway pressure (BiPAP) therapy. His res- 
piratory status improved with further uncomplicated hospital course. 
He was continued to metronidazole and ceftriaxone for five weeks after 
discharge. After completion of his antibiotic regimen, he was subse- 
quently lost to follow-up.

3. Illustrative Case II

A 12-year-old Egyptian male with seasonal allergies and remote 
history of adenotonsillectomy presented to an outside ED with nasal 
congestion and progressive right eye swelling for three days. He was 
evaluated by his pediatrician the day prior and started on oral amox- 
icillin/clavulanate and ofloxacin eye drops. CT revealed right-sided 
confluent collection with mucopurulence and hemorrhagic contents was 
formed on an outpatient, non-emergent basis after the patient tested 
negative for SARS-CoV-2 RNA. He was transferred to our facility. Table 1 highlights his laboratory values. SARS-CoV-2 RNA 
testing was positive. Vancomycin and ceftriaxone were administered, 
and he was taken to the OR expediently by the ophthalmology team for 
right orbitotomy and drainage of abscess (Fig. 4). He was discharged to 
our facility.

Previously published COVID-19 guidelines have recommended de- 
ferment of operative intervention and initiation of maximal medical 
therapy for 48–72 h in patients with “complicated acute rhinosinusitis 
with orbital extension without vision or globe compromise” [13]. This 
is consistent with a recent systematic review by Wong et al. which re- 
commended 48 h of parenteral antibiotic therapy for postseptal cellu- 
laris in the pre-COVID-19 era [2]. Despite optimizing medical care, the 
clinical condition of the patient in Case I continued to worsen with the 
development of SOVT. Derangements in coagulation profiles and the 
resulting sequalae in patients with COVID-19 have been previously 
reported throughout the pandemic, including myocardial infarction, 
ischemic stroke, limb ischemia, and cerebral venous thrombosis among 
others [14–17]. Urgent ESS in Case I was felt necessary to decrease the 
risk of developing cavernous sinus thrombosis and further neurologic 
complications [1]. In contrast, Case II responded well to initial orbital 
abscess drainage and improved clinically without immediate need for 
ESS. ESS was eventually required, although this was able to be per- 
formed on an outpatient, non-emergent basis after the patient tested 
negative for SARS-CoV-2 RNA.

In Case I, our patient was noted to experience new onset respiratory 
deterioration following operative intervention. A retrospective review 
from Wuhan, China examined 34 patients who underwent surgery 
during the asymptomatic incubation period [18]. 44% of the patients 
subsequently required ICU admission for respiratory deterioration with 
a mortality rate of 20.5%. A more recent and extensive review from 235 
hospitals in 24 countries revealed postoperative pulmonary complica- 
tions occur in half of patients with perioperative SARS-CoV-2 infection. 
The 30-day mortality in this patient cohort was noted to be 23.8% [19]. 
Worsening postoperative pulmonary status is consistent with our pa- 
tient in Case I, highlighted by the necessity of PICU care and maximum 
non-invasive oxygen supplementation. Possible pulmonary complica- 
tions from undergoing general anesthesia (up to 10%) is a known risk 
although patients with concomitant SARS-CoV-2 infection seem to have
increased risk, likely due to the pro-inflammatory cytokine and immunosuppressive responses to surgery and mechanical ventilation [20–22]. This provides further evidence to possibly raise the threshold for operative intervention in COVID-19 patients, with need for close postoperative monitoring.

5. Conclusion

COVID-19 remains a novel threat to both the adult and pediatric populations. The cases provided in this report highlight the unique challenge of caring for pediatric patients presenting with complicated rhinosinusitis and concomitant COVID-19 infection. We recommend utilizing a multi-disciplinary approach in optimizing care of these patients when at all feasible. Further research is still needed to further elucidate the complex pathophysiology and optimal treatment algorithms of SARS-CoV-2 patients with complicated rhinosinusitis.

Financial disclosures

None.

Declaration of competing interest

None.

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| Lab value   | Case I | Case II | RV   | Lab value   | Case I | Case II | RV   |
|-------------|--------|---------|------|-------------|--------|---------|------|
| Hemoglobin  | 13.2   | 14.1    | 13.0–16.0 g/dL | Urea   | 11  | 10  | 4–19 mg/dL |
| Hematocrit  | 40.1   | 41.7    | 37.0–49.0%  | Creatinine | 0.9 | 0.55 | 0.7–1.2 mg/dL |
| Leukocytes  | 7.5    | 6.5     | 4.5–13.0 × 10⁹/µL | CRP    | 169 | 22  | 0–5 mg/L |
| Lymphocytes | 10.7   | 38.0    | 20.0–50.0%  | ESR    | 34  | NA   | 0–5 mm/h |
| Monocytes   | 12.1   | 7.0     | 2.0–12.0%   | Ferritin | 1216 | NA  | 20–400 ng/mL |
| Platelets   | 122    | 281     | 150-450 × 10⁹/µL | CRP    | 169 | 22  | 0–5 mg/L |

RV = reference value. CRP = C-reactive protein. ESR = erythrocyte sedimentation rate. Bold represents an abnormal value.
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