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Management of complicated acute sinusitis in the setting of concurrent COVID-19

Kevin Guy, Matthew Lelegren, Kyrie Shomaker, Joseph Han, Kent Lam *

Department of Otolaryngology/Head & Neck Surgery, Eastern Virginia Medical School, Norfolk, VA, United States of America

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ABSTRACT

Purpose: Intraorbital and intracranial complications of acute bacterial rhinosinusitis require timely medical and surgical treatment to prevent the development of long-term neurologic sequelae. The era of Coronavirus Disease-2019 (COVID-19) has complicated the management of complicated acute rhinosinusitis, especially when patients have concurrent acute sinusitis and COVID-19 infection. This case series aims to highlight the clinical course of pediatric patients at a single tertiary pediatric hospital with concurrent complicated bacterial rhinosinusitis and COVID-19.

Materials and methods: A search of pediatric patients treated for COVID-19 and complications from acute sinusitis was performed using billing records for the year 2020–2021 at a single pediatric tertiary hospital. Data regarding presentation, management, microbiology, and hospital course was collected for review.

Results: A total of 6 patients with complicated bacterial sinusitis in the setting of COVID-19 infection were included. All patients were initially managed with medical therapy, consisting of systemic antibiotics, but 3 of these patients ultimately required surgical intervention. Cultures from the cohort grew *Staphylococcus aureus*, *streptococcus intermedius*, *streptococcus constellatus* or *Prevotella* species. All patients experienced clinical improvements and were eventually discharged home with oral antibiotics.

Conclusion: COVID-19 continues to be an unusual disease especially for the pediatric population. Concurrent complicated acute rhinosinusitis and COVID-19 appear to have higher rates of surgical requirement in the pediatric population. COVID-19 safety precautions have influenced management practices for patients with severe bacterial rhinologic infections. While there may be an association between complicated bacterial rhinosinusitis and COVID-19 infection, further research is necessary to determine a true correlation.

1. Introduction

Complicated rhinosinusitis is defined as orbital or intracranial extension of acute bacterial rhinosinusitis [1,2]. Viral infections are a known possible precursor of bacterial rhinosinusitis due to impairment of the normal muco-ciliary clearance of the paranasal sinuses [1,2]. Due to the anatomical location of the paranasal sinuses, infections in these regions can extend into the orbital, pre-septal, or intracranial spaces and result in cellulitis or abscess, resulting in symptoms of orbital swelling, fever, headaches, and nasal obstruction [3]. Initial treatment typically consists of broad-spectrum antibiotics, and surgery is usually offered in refractory cases [3].

The virus that causes the Coronavirus Disease-2019 (COVID-19), SARS-CoV-2, is generally found residing in the nasopharynx [4]. Hallmark rhinologic symptoms of SARS-CoV-2 include hyposmia or

anosmia, nasal obstruction, and rhinorrhea [5]. Despite high global impact of COVID-19, there are few studies detailing sinus disease with simultaneous COVID-19 [4–7]. This case series aims to highlight the medical and surgical management of pediatric patients who developed complicated rhinosinusitis in the setting of COVID-19 infection.

2. Case presentations

2.1. Case 1

A 12-year-old Caucasian male presented to our tertiary pediatric hospital with 4 days of left periorbital swelling, pain, headache, and nasal discharge. At our institution, he was found to be positive for COVID-19 and a computed tomography (CT) scan of his head demonstrated prominent soft tissue swelling overlying the left orbit likely

* Corresponding author at: Gresham Drive Suite #1100, Norfolk, VA 23507, United States of America.

E-mail address: LamKK@evms.edu (K. Lam).

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related to left lacrimal duct obstruction and severe acute sinusitis.

Otolaryngology and ophthalmology were consulted, and recommendations consisted of intravenous (IV) ceftriaxone and clindamycin, a nasal regimen with oxymetazoline, saline and intranasal corticosteroid, and a dose of IV dexamethasone. Re-evaluation of the patient on hospital day 2 showed definite chemosis of the left lateral sclera and a palpable tender mass just below the left lateral eyelid ridge. Repeat CT scan demonstrated acute pansinusitis with near complete opacification of the left maxillary sinus and a left subperiosteal abscess measuring 2.9 cm × 1.1 cm.

On hospital day 3, the patient was taken to surgery by both ophthalmology and otolaryngology for left orbitotomy with abscess drainage, and left maxillary antrostomy, total ethmoidectomy, and sphenoidotomy. Purulence was noted in all left-sided sinuses. The case was performed by the attending rhinologist without the presence of the otolaryngology residents to limit COVID-19 exposure. Orbitotomy demonstrated an abscess extending 2.5 cm beyond the left orbital rim. Cultures at the time grew *streptococcus intermedius* and *Prevotella loescheii*. The patient's condition rapidly improved after surgery, resulting in discharge on post-operative day 2 with a 10-day course for amoxicillin/clavulanate and clindamycin and a nasal regimen.

2.2. Case II

A 12-year-old African American male presented to our tertiary pediatric hospital with left-sided maxillary pain and swelling. A viral respiratory panel on arrival revealed positivity for COVID-19. A CT scan demonstrated left maxillary, frontal, and ethmoid sinusitis with subperiosteal abscess formation extending along the medial and lateral margins of the frontal process of the left maxilla and associated left malar periorbital and nasal cavity soft tissue swelling.

Otolaryngology and ophthalmology were consulted, and recommendations consisted of IV clindamycin and ceftriaxone, nasal regimen with intranasal corticosteroid, oxymetazoline, and saline rinses, and IV dexamethasone. Re-evaluation of the patient on hospital day 2 demonstrated no improvement in symptoms. Repeat CT scan demonstrated pansinusitis, with complete opacification of the left maxillary, ethmoid, and frontal sinuses, left facial and periorbital/preseptal soft tissue swelling. On hospital day 3, the patient was taken to surgery by otolaryngology for left frontal sinusotomy, total ethmoidectomy, maxillary antrostomy, and sphenoidotomy. The case was performed by the attending rhinologist without the presence of the otolaryngology residents to limit COVID-19 exposure. Cultures at the time of procedure grew few *Streptococcus constellatus*. The patient's pain, swelling and nasal breathing improved after his surgery, and he was discharged on post-operative day 3 with oral clindamycin and amoxicillin/clavulanate and a nasal regimen.

2.3. Case III

A 14-year-old African American male presented to our tertiary pediatric hospital with fevers, left-sided facial pain, left-sided eye pain, and right lower extremity weakness. Eight days prior to presentation our patient tested positive for COVID-19. CT demonstrated left parafalcine empyema extending along the left side of the tentorium, small lobulated left frontal subdural empyema, acute pan-sinusitis, with predominant involvement of the left-sided cavities, and small subperiosteal abscess in the inferior frontal/lateral periorbital region measuring 22 mm × 7.6 mm (Fig. 1). The patient was taken to the operating room by neurosurgery for craniotomy and empyema evacuation. He tolerated the procedure well and was started on IV penicillin and metronidazole. Cultures taken at the time grew *Streptococcus constellatus*.

Otolaryngology also evaluated the patient for pansinusitis and left periorbital abscess. He was started on nasal regimen with oxymetazoline, intranasal corticosteroid, and saline rinses. His symptoms did not improve and was consequently taken to the operating room on hospital

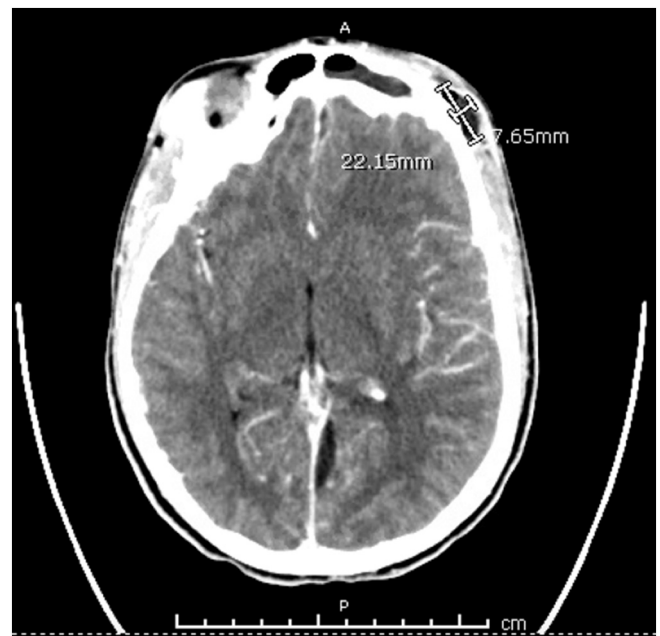


Fig. 1. CT scan of the head in a patient with complicated rhinosinusitis (case III). This image demonstrates a left sub-periosteal abscess measuring 22.5 mm by 7.65 mm.

day 4 for left endoscopic sinus surgery. His periorbital abscess was also incised and drained. The case was performed by the attending rhinologist without the presence of the otolaryngology residents in order to limit COVID-19 exposure. His post-operative course was complicated by cavernous sinus thrombosis, which required ophthalmology consultation for left sixth cranial nerve palsy.

The patient's right lower extremity weakness failed to improve eight days after his empyema evacuation procedure. Repeat CT of the head demonstrated worsening empyema. The patient was subsequently taken back to the operating room by neurosurgery for repeat craniotomy and empyema evacuation. Cultures taken during this procedure grew *Streptococcus constellatus* and *Prevotella* species. The patient's right lower extremity weakness slowly improved, and he was discharged home 36 days after initial presentation.

2.4. Case IV

A 2-year-old African American female was brought to our tertiary pediatric hospital with a 4-day history of right orbital swelling. CT demonstrated paranasal sinus disease with extension into the right retro-orbital soft tissues with a 3.6 mm subperiosteal abscess and proptosis of the right globe. The patient was also found to be positive for COVID-19. Otolaryngology was consulted and recommended medical management with ampicillin/sulbactam, IV dexamethasone, and a nasal regimen. The patient's symptoms improved, and she was discharged on hospital day 3 with oral amoxicillin/clavulanate.

2.5. Case V

A 14-year-old African American male presented to our tertiary pediatric hospital with a 7-day history of headaches and left eye swelling. CT demonstrated left sinusitis and preseptal cellulitis. He was also positive for COVID-19. The patient was started on IV ceftriaxone, vancomycin, and metronidazole. Otolaryngology was consulted and recommended medical management with antibiotics and nasal regimen. Despite this treatment, the patient developed altered mental status, increased swelling, and oxygen desaturations. MRI demonstrated left sinusitis with frontal bone osteomyelitis, frontal scalp cellulitis, bilateral

temporalis myositis, and venous thromboses in the superior sagittal sinus, right frontal superficial cortical vein, left frontal intraosseous vein, and left superior ophthalmic vein. The patient was continued on a nasal regimen and IV ceftriaxone, vancomycin, and metronidazole. The patient's condition improved over the next 3 days on this regimen and was ultimately discharged on hospital day 6 with a nasal regimen and a 30-day course of oral clindamycin and amoxicillin/clavulanate.

2.6. Case VI

A 4-year-old African American male presented to our tertiary pediatric hospital with worsening right orbital swelling and erythema (Fig. 2). The patient was found to be COVID-19 positive. CT demonstrated right pansinusitis and right orbital cellulitis with subperiosteal and anterior right nasal passage abscesses measuring 2.4 cm × 2.1 cm. He was started on IV vancomycin and ceftriaxone. Otolaryngology was consulted and recommended medical management with antibiotics and nasal regimen. The patient's right orbital swelling improved over the next 3 days and was discharged on hospital day 4 with intranasal corticosteroids and a 21-day course of cefdinir and clindamycin.

3. Discussion

Viral upper respiratory infections, among other obstructing rhinologic diseases, are a well-known precursor for acute rhinosinusitis especially in the pediatric population. Sinonasal inflammation induced by viral infections impairs the mucociliary system and obstructs the normal sinus drainage, ultimately resulting in acute bacterial sinusitis [8]. Unchecked infections in the frontal and ethmoid sinuses are most likely to result in complicated rhinosinusitis due to thin sinus walls that separate the sinuses from surrounding orbital tissue [9].

Illnesses with concurrent COVID-19 infections can be difficult to manage and treat with respect to safety precautions, especially because manipulation of the nasal cavities may promote aerosolization of the SARS-CoV-2 virus. Current published COVID-19 pediatric guidelines state that procedures involving the nasal cavity and nasopharynx “pose a high risk of COVID-19 due to high viral burden in these anatomic locations and should be deferred whenever possible” [10].

Additionally, these guidelines suggest that children who require hospitalization for complicated sinusitis with orbital extension without vision or globe compromise should be trialed on antibiotics, corticosteroids, and nasal regimens for 48 to 72 h before considering surgical therapy [10]. A systematic review by Wong et al. on the pre-COVID-19 management of complicated sinusitis recommends a similar approach to treatment. Specifically, in the case of pre-septal/orbital cellulitis, a 48-hour trial of antibiotics should be given before surgery should be

considered [11]. Additionally, in the case of subperiosteal abscess without optic nerve involvement, surgery and antibiotic therapy should be considered first-line in patients with frontal sinus involvement and/or abscess size greater than 3.8 milliliters [11]. If the abscess is smaller than 3.8 ml and there is no involvement of the frontal sinuses, 48 h of antibiotic therapy should be trialed before surgical intervention [11]. Finally, any cases of subperiosteal abscess with optic nerve involvement, intraconal/orbital abscess, or cavernous sinus thrombosis should be managed with surgical intervention and antibiotics [11].

COVID-19 precautions offer a unique challenge when it comes to patient care, as evidenced by our case series. Summaries of patient demographic data and hospital course can be found in Tables 1 and 2, respectively. This series found that half of patients with COVID-19 and complicated acute sinusitis ultimately required surgical intervention, despite early initiation of antibiotic regimens. This represents an increased need for surgery as opposed to pediatric patients with complicated acute sinusitis before the start of the COVID-19 pandemic [12]. In these cases, COVID-19 precautions may have delayed surgical intervention that was ultimately necessary to manage the patients' complicated sinusitis.

Our case series also highlights the impact of the COVID-19 era on resident education. In the cases that required surgical intervention, residents were not included in the procedure in order to limit their risk of exposure to COVID-19. A study by Wise et al. has characterized the impact of COVID-19 on residents within surgical fields. The findings included a decrease in resident caseload and time spent operating, and an overall heightened concern regarding resident's future ability to care for patients with COVID-19 [13]. Consequently, more surgical residents are taking this opportunity to improve academically and carry out research [13].

Overall, initial medical treatment with broad-spectrum antibiotics and nasal regimen including intranasal corticosteroid, oxymetazoline, and saline rinses proved to be a reasonable first line therapy for our patients. Surgical options should be saved for cases that fail to respond to this treatment, or cases that pose an immediate risk to surrounding anatomical structures.

4. Conclusion

COVID-19 continues to be an unusual disease especially for the pediatric population. The management of patients with simultaneous complicated acute sinusitis and COVID-19 may involve both medical therapy, consisting of systemic antibiotics, or surgical intervention to reduce the infectious burden in the paranasal sinuses. There appears to be an increased requirement for surgical intervention in pediatric patients with complicated acute rhinosinusitis and COVID-19 as opposed to pediatric patients without COVID-19. While there are no absolute treatment algorithms, management should be guided by the clinical progression of the concurrent complicated acute sinusitis and COVID-19 infection. Despite the occurrence of simultaneous bacterial and viral infections in the paranasal sinuses, further studies are required to fully understand the correlation and underlying pathogenesis of this association.



Fig. 2. Right periorbital swelling and discharge in a 4-year-old patient with orbital cellulitis (case VI).

Table 1 Summary of demographic information and medical history of pediatric patients with concurrent complicated acute bacterial sinusitis and COVID-19 infection.

Case #	Age	Gender	Race	History of atopy
I	12	Male	White	Yes
II	12	Male	Black	No
III	14	Male	Black	Yes
IV	2	Female	Black	No
V	14	Male	Black	No
VI	4	Male	Black	Yes

Table 2

Summary of hospital course for cases of concurrent COVID-19 and complicated acute bacterial sinusitis.

Case #	Radiologic findings	Laterality of disease	Surgical intervention required? (hospital day of procedure)	Culture results	Length of stay
I	Pansinusitis, subperiosteal abscess	Left	Yes (3)	<i>Streptococcus intermedius</i> & <i>Prevotella</i> sp.	6
II	Pansinusitis, subperiosteal abscess	Left	Yes (3)	<i>Streptococcus constellatus</i>	6
III	Pansinusitis, subdural empyema, subperiosteal abscess	Left	Yes (4)	<i>Streptococcus constellatus</i> & <i>Prevotella</i> sp.	36
IV	Pansinusitis, subperiosteal abscess	Right	No	Not cultured	3
V	Pansinusitis, frontal bone osteomyelitis	Left	No	Not cultured	6
VI	Pansinusitis, subperiosteal abscess	Right	No	Not cultured	4

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Declaration of competing interest

The authors have no conflicts of interest to disclose.

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