Pott's Puffy Tumour in Mucormycosis: New Presentation of an Old Disease

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ABSTRACT

Introduction

Pott's puffy tumour (PPT) is a rare but grave complication of frontal sinusitis. During the second wave of Covid-19, there was rise in rhino-orbito-cerebral mucormycosis (ROCM) cases in India. There is a paucity of literature reporting association of frontal osteomyelitis with rhino-orbital cerebral mucormycosis. This study elucidates the clinico-epidemiological profile and clinical outcomes of management of frontal osteomyelitis in patients with ROCM.

Materials and Methods

A retrospective, observational study was conducted at a tertiary hospital from May 2021 to May 2022. 350 patients with covid-19 associated ROCM had reported to the hospital. 12 patients presenting either pre- or post-operatively with doughy swelling over the forehead, with/without oedema of the upper eyelid were clinically diagnosed to have frontal osteomyelitis. Minimal localised defects in the frontal bone were subjected to local excision of granulation tissue, evacuation of pus and biopsy. Cases involving extensive erosions of anterior table of frontal sinus underwent osteoplastic flap with obliteration.

Results

12 patients presented with frontal osteomyelitis. All received systemic antifungals and broad-spectrum antibiotics. It sufficed in only 1 case. 2 required additional local debridement. In 4, endoscopic sinus surgery achieved adequate disease control. 5 with extensive disease required osteoplastic flap with obliteration via either eyebrow or bicoronal incision.

Conclusion

A high index of suspicion is warranted in patients with covid-19 associated mucormycosis who present with a forehead swelling because even though PPT is a rare clinical entity it is associated with potentially life-threatening complications.

Keywords

Pott's puffy tumor; Frontal osteomyelitis; Mucormycosis

Pott's puffy tumour (PPT) is an unusual but potentially lethal complication of sinusitis.[1] Sir Percivall Pott first described Pott's puffy tumour in 1768 as "a subperiosteal abscess in the forehead resulting from a trauma". He subsequently reported that this disorder resulted from frontal sinusitis.[2,3] It is a doughy swelling over the forehead, with oedema of the upper eyelid, which most commonly signifies an osteomyelitis of the frontal bone as a complication of sinusitis.[4,5,6]

The exact pathophysiology is unclear. It is postulated that it may occur as a result of spread of infection through venous drainage of the frontal sinus or from direct extension of the infection through the bone.[7] If infection spreads through bone, it leads to demineralization with necrosis, resulting in osteomyelitis of the frontal bone and the formation of subperiosteal abscesses.[8] The mucosal venous drainage of the frontal sinus occurs through diploic veins, which communicate with the dural venous plexus. Septic thrombi can potentially evolve from foci within the frontal sinus and propagate through this venous system. Thus, intracranial involvement is possible with or without

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direct erosion of the frontal bone.[9] Intracranial involvement may present as subdural empyema, meningitis, epidural, subdural, or intraparenchymal abscess, and cortical vein thrombosis.[10]

Majority of reported cases in post antibiotic era involve adolescents. Aetiopathogenesis is hypothesised to be due to (1) an anatomically undeveloped frontal sinus- anterior table of frontal sinus is much thinner in adolescents than in adults, (2) increased blood flow in the diploic veins in adolescence, and (3) higher incidence of upper respiratory tract infections and an increased risk of acute bacterial sinusitis.[11, 12] Older patients are less likely to be afflicted or present with complications, in the absence of predisposing factors such as immunocompromise, trauma, or prior surgery.

Most cases of frontal osteomyelitis have largely been attributed to adverse sequelae of head trauma. Other causative factors mentioned in literature include frontal sinusitis, following craniotomy as a late complication, spread of infection from adjacent sites, such as dental sepsis and otitis media, immunosuppression, intranasal cocaine abuse, or even insect bite.[11] Organisms isolated were almost always aerobic bacteria such as staphylococci. Reports of frontal osteomyelitis secondary to mucormycosis have been scarce.

Rhino-orbital cerebral mucormycosis usually has a focus in the nasal mucosa from where it spreads to the sinuses, orbit and cranial cavity.[13] Maxillary and ethmoid sinuses are more frequently involved with involvement of the frontal sinus being rare.

With the arrival of the second wave of the covid-19 pandemic, there was increase in mucormycosis cases. In a retrospective multicenter study conducted in India between September to December 2020, it was found that prevalence of CAM in hospitalised patients was 0.27% (2.1 fold rise in cases).[14] The epidemic also brought with it an upsurge in involvement of frontal sinus. Frontal sinusitis in some progressed to osteomyelitis involving either anterior or posterior table or lead to frank osteonecrosis with erosions. They presented with a forehead swelling or with multiple discharging sinuses.The objective of this study was to elucidate the clinico-epidemiological profile and clinical outcomes of management offrontal osteomyelitis in patients with rhino-orbital cerebral mucormycosis.

Materials and Methods

A retrospective, observational study was conducted in the Department of Otorhinolaryngology at a tertiary hospital in India from May 2021 to May 2022. Patients who were post-covid RTPCR (reverse transcriptase polymerase chain reaction) negative with histopathologically and/or radiologically proven mucormycosis [European Organization for Research and Treatment of Cancer/Mycoses Study Group (EORTC/MSG group)][15] with pott's puffy tumour were included in the study.Patients who were RTPCR positive, or had frontal osteomyelitis secondary to trauma were excluded from the study.. A total of 350 patients with rhino-orbital cerebral mucormycosis (ROCM)were admitted at our centre.

Patients presenting either pre or post-operatively with doughy swelling over the forehead, with/without oedema of the upper eyelid were clinically diagnosed to have frontal osteomyelitis (Fig. 1).

12 out of 350 patients with ROCM presented with Pott's puffy tumour. The proforma for each patient

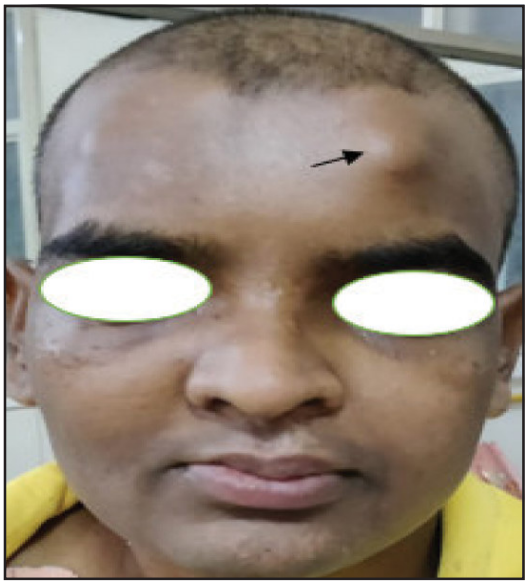

Fig. 1. Patient with frontal osteomyelitis

encompassed history, complete general physical, systemic and ENT examination. In all the patients, routine blood examinations, and contrast enhanced magnetic resonance imaging (CEMRI) with computerised tomography (CT) scans of the paranasal sinuses, orbit and brain were done (Fig. 2).

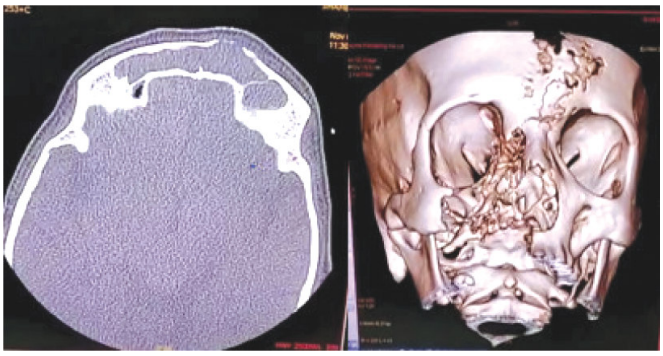

Fig. 2. CT scan and 3D reconstruction showing erosion of outer table of frontal sinus

Diagnosis was confirmed radiologically with CT or CEMRI. CT classically demonstrates an opacified frontal sinus with stranding and subcutaneous swelling of the overlying scalp. Bone algorithm will often exhibit a defect in the anterior table of the sinus. Contrast allows intracranial complications to be better delineated and may reveal a focal abscess.[16] CEMRI may indicate linear enhancement of the dura mater, an extra-axial fluid collection, or an area of cerebritis or focal cerebral abscess formation. In the scalp, when an organized fluid collection is present, peripheral or rim contrast enhancement may be seen.[17]

Cases presenting with localised frontal swelling and intact posterior wall of frontal sinus were initially managed with combination of broad-spectrum antibiotics (ceftriaxone/ doxycycline/ ciprofloxacin/meropenem/ piperacillin-tazobactam with metronidazole)in addition to intravenous posaconazole for two weeks. Intracranial complications were managed as per neurosurgeon/ neurologist opinion. If in two weeks there was no improvement in the size of the swelling over forehead or new swellings appeared, then patients with minimal localised defects in the frontal bone were subjected to local excision of granulation tissue, evacuation of pus and biopsy. Cases involving extensive erosions of anterior table of frontal sinus underwent osteoplastic flap with obliteration. Access was gained via a bicoronal or eyebrow (spectacle/gullwing) incision, anterior table was completely removed, disease process cleared and the cavity obliterated with abdominal fat (Fig.3 & 4). Cases with erosion of the posterior table as well underwent cranialisation via similar incisions. Dead space between the pericranial flap and dura was filled with fat. In both circumstances, the external approach was combined with an endoscopic frontal sinusotomy. The frontal sinus was then separated from the nasal cavity with a sheet of fascia or periosteum. Endoscopic surgical debridement of other involved paranasal sinuses was done. Excised osteomyelitic bone, granulation tissue and sinus mucosa was sent for microbiological (KOH, fungal culture) and histopathological examination for confirmation of diagnosis of mucormycosis.

Postoperatively, patients received broad spectrum

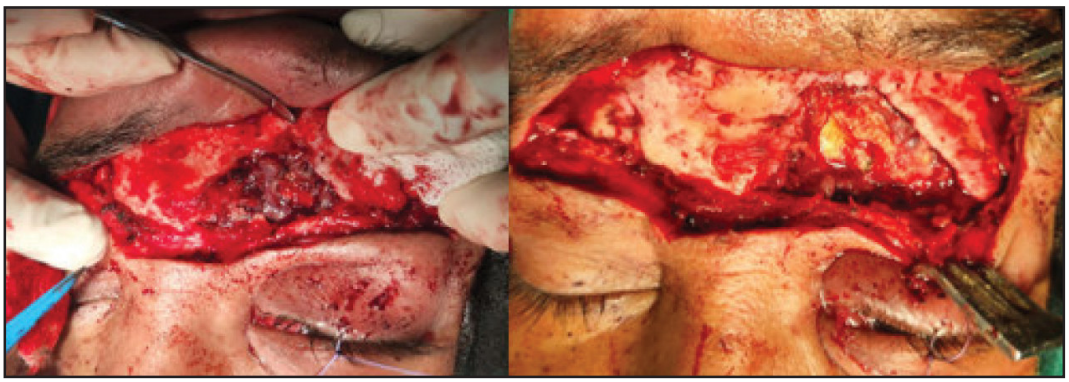

Fig. 3. Intraoperative image showing necrotic tissue and bone involving left frontal sinus

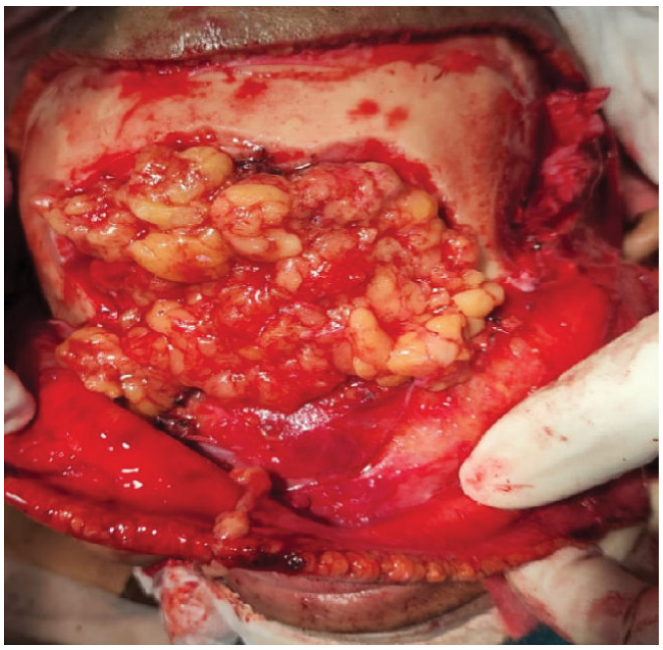

Fig. 4. Obliteration of dead space in frontal sinus with abdominal fat

antibiotics and intravenous posaconazole for a period of 14 days. They were discharged on oral antibiotics and tablet Posaconazole was continued for 6 weeks. They were followed up at regular intervals; once weekly for the first month, once in two weeks for the next month and then monthly thereafter. Diagnostic nasal endoscopy was done at each visit.Data was tabulated and charted using Microsoft Excel 2010. Categorical variables were described as counts and percentages. Descriptive analysis of quantitative variables was done using mean and standard deviation at a confidence level of 95%. A Chi-square test of independence was performed to examine the relation between the variables.

Results

350 patients with ROCM were treated at our centre. 12 patients in this large cohort (9 males (73%) and 3 (27%) females) presented with a swelling over the forehead (Fig.5). Incidence rate in the population under observation was estimated to be 31.43 per 1000 population.Frontal headache was a presenting complaint in all. 8 patients (66.67%) had swelling extending to involve the upper eyelid.

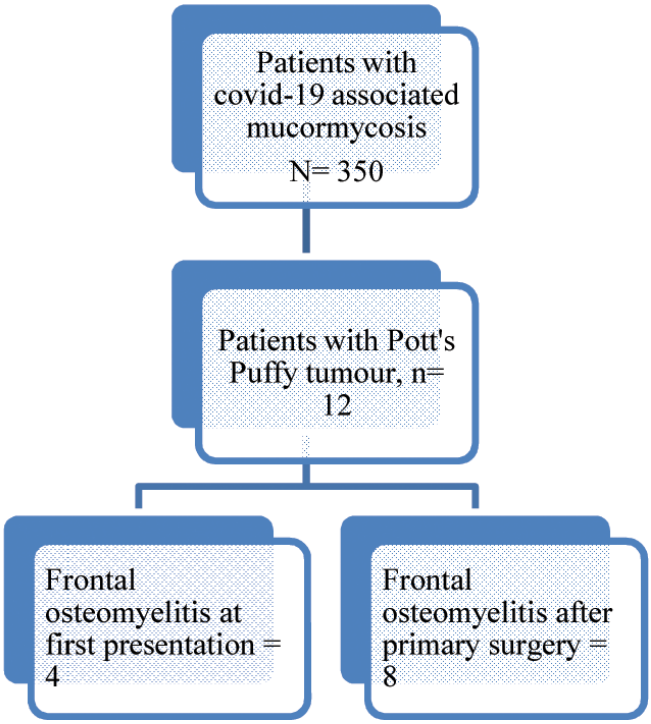

Fig. 5. Patients with Pott's Puffy Tumour

The mean age of those afflicted was 47.75 ± 10.29 years. 58.3% of those affected were over 50 years. Type 2 diabetes mellitus was a comorbidity in all those presenting with osteomyelitis of the frontal bone. None of the 12 patients had been immunised against Covid-19 (Table 1).

The incidence rate of intracranial complications was 50% (6 of 12 cases). The most common complication was pachymeningitis (4 cases) followed by cerebral abscess in 2 patients. The patients however presented no symptoms of intracranial involvement except headache. There was no latency between appearance of forehead swelling and presentation with intracranial complication. 4 of the patients with these complications went on to require frontal craniectomy. Correlation between evidence of intracranial complications and age ($p = 0.82$, Chi-square test) or gender ($p = 0.39$, Chi-square test) was not statistically significant.

Table I : Clinico-epidemiological profile and management of patients with Pott's puffy tumour (ESS – Endoscopic Sinus Surgery)

CHARACTERISTICS	NO. OF CASES, N = 12
Incidence of Pott's puffy tumour in study population	**31.43 per 1000 population**
Age	
<30 years	**1 (8.3%)**
30-50 years	**4 (33.3%)**
>50 years	**7 (58.3%)**
Mean	**47.75 ± 10.29 years**
Gender	
Male	**9 (75%)**
Female	**3 (25%)**
Ratio	**3:1**
Diabetes Mellitus	**12 (100%)**
Newly detected	**2 (16.7%)**
COVID-19 immunisation status	**0 (All patients were not immunised against covid-19)**
Frontal Osteomyelitis	
At presentation (before primary ESS)	**4 (33.3%)**
Postoperative (after primary ESS ± revision ESS)	
1. < 3 months	**3 (25%)**
2. 3-6 months	**4 (33.3%)**
3. >6 months	**1 (8.3%)**
Clinical Presentation	
1. Headache	**12 (100%)**
2. Upper eyelid oedema	**8 (66.7%)**

Table I : Contd.

Table I (Contd.) : Clinico-epidemiological profile and management of patients with Pott's puffy tumour (ESS – Endoscopic Sinus Surgery)

CHARACTERISTICS	NO. OF CASES, N = 12
Intracranial Complications	
Present	**6 (50%)**
1. Pachymeningitis	**4 (33.3%)**
2. Cerebral abscess	**2 (16.7%)**
Absent	**6 (50%)**
Management of frontal osteomyelitis	
1. IV broad spectrum antibiotics	**1 (8.3%)**
2. Endoscopic bilateral frontal sinus clearance	**4 (33.3%)**
3. Local debridement	**2 (16.7%)**
4. Osteoplastic flap with obliteration	**5 (41.7%)**
Time from onset to frontal sinus surgery	
● **< 1 month**	**4 (33.3%)**
● **1 - 3 months**	**6 (50%)**
● **> 3 months**	**2 (16.7%)**
Average time from onset to radical surgery	**3.6 months**

The mean time between primary debridement of the sinuses and the involvement of the frontal bone was 6 ± 13.4 months. Only 4 patients had a palpable forehead swelling and scans suggestive of frontal bone osteomyelitis before undergoing primary endoscopic sinus surgery. All of them underwent bilateral frontal sinus clearance in addition to debridement of other sinuses. In two patients the forehead swelling persisted despite surgery and adequate antibiotics and antifungals. They required further surgical intervention.

9 patients had undergone primary endoscopic sinus debridement for sinonasal mucormycosis elsewhere. 4 out of these 9 subsequently underwent revision debridement and/or maxillectomy at our centre before eventually presenting with Potts' Puffy tumour at a later date.

Only 1 patient out of 12 could be effectively managed with intravenous antibiotics and antifungals alone. The forehead swelling resolved with two weeks of medical treatment and he required no further surgical intervention. He remained symptom free at his 6-month follow-up. Endoscopic frontal sinus clearance alone sufficed in 4 patients and the forehead swelling subsided post-surgery. There were no recurrences at 6 months postoperatively. 2 patients required additional local debridement and evacuation of pus after endoscopic frontal sinus clearance.

The remaining 5 patients underwent frontal sinus clearance via external approach. The average period from patients' initial forehead swelling to the radical surgical drainage procedure (bicoronal flap/eyebrow incision) was 3.6 months. The pericranial flap was raised via bicoronal incision in 3 patients, while the eyebrow incision was used in the other two patients. The postop period was uneventful in all. 3 patients required ICU stay postoperatively for an average of 2 days. All 5 could be discharged on schedule after 2 weeks of intravenous antibiotics and antifungals. (Fig. 6)

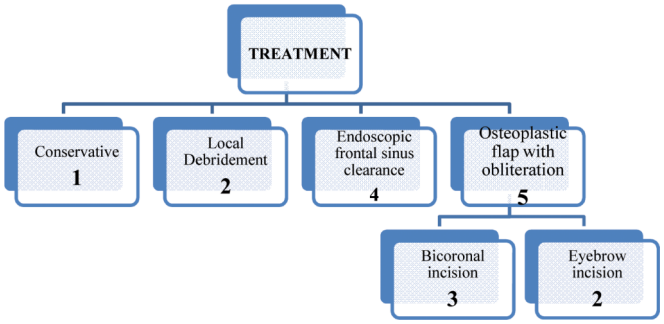

Fig. 6. Treatment of Frontal osteomyelitis

At 6 months follow-up, the patients who underwent external frontal craniectomy, showed no recurrence. There were no serious deficits except loss of forehead contour due to resorption fat used to fill the dead space. Only 1 patient succumbed to fulminant mucormycosis despite adequate endoscopic frontal sinus clearance. Cause of death was ascertained to be pulmonary embolism and sepsis secondary to complete unilateral internal jugular vein thrombosis.

Discussion

Association of frontal osteomyelitis with mucormycosis has beenestablished in only 3 case reports in the pre-COVID-19 era. A case of Pott's puffy tumour in a diabetic patient with renal failure was reported by Effat et al in 2005. The patient did not respond to intravenous antibiotics and further investigation revealed that the patient had mucormycosis. They outline and discuss recent therapeutic modalities such as growth factors and liposomal amphotericin B and emphasize timely adequate surgical intervention - all of which have improved the prognosis in this serious condition.[18] Verma et al. in 2013 reported a case of extensive rhino-cerebral mucormycosis in a 58-year-old female diabetic who presented with erosion virtually of the whole facial skeleton particularly the palate, left maxillary sinus and frontal sinuses. Management of the frontal sinus was similar to our treatment strategy and included removal of outer and inner tables and establishment of drainage through frontal sinus. Patient was discharged after 15 days in good general condition & amphotericin B was continued for 6 months. No recurrence was noted at 1 year.[19] Our patients received intravenous liposomal amphotericin B only for 15 days and were discharged on oral Posaconazole for 6 weeks. Sahoo et al in 2017 presented a case of rhino-orbital cerebral mucormycosis of frontal sinus in a diabetic patient, who was managed with systemic antifungals, surgical debridement, and obliteration procedures.[20]

The gold standard in the treatment of frontal osteomyelitis, whether due to bacterial or fungal aetiology, is systemic antibiotic and/or antifungal therapy in tandem with debridement of the sinus. In early cases, in addition to antifungal therapy, a broad-spectrum antibiotic with good blood-brain barrier passage can suffice to clear the infection and prevent further intracranial spread[10], as was demonstrated in one of our patients who was cured with only broad-spectrum antibiotics in addition to antifungals. All other patients however required surgical debridement in addition to medical management.

Despite the variety of surgical approaches described in literature, there is no consensus on the treatment algorithm and timing of surgery. Each surgical procedure brings with it its own complications. External drainage while having the advantage of providing complete access the frontal sinus, particularly in patients with laterally located or advanced disease, has the drawback of an external scar and the possibility of sino-cutaneous fistula. Minimally invasive endoscopic drainage on the other hand limits morbidity, scarring, and convalescence but cases of lateral lying pathology, orbital wall dehiscence, and erosion of the posterior table can be difficult to manage in an endoscopic only approach. The best modality would

therefore be to perform endoscopic surgery in cases with limited accessible disease, switching to a combined approach in cases with extensive involvement of both tables of the frontal sinus.

Sideris et al., suggest that in cases with gradual resolution of symptoms and no intracranial complications on treatment with iv broad-spectrum, antibioticsthe surgical intervention should be scheduled after a minimum of 20 days so that the inflammation levels have been reduced.[21] Even though in our study it took an average of 3.6 months for a patient with extensive erosions to undergo radical surgery, we found no instances of lethal intracranial complications or focal neurological deficits. The major limitation of our study is that since an overwhelming majority of our cases of PPT underwent initial treatment and surgery elsewhere, we weren't able to more thoroughly examine the pathogenesis of osteomyelitis in these patients.

Conclusion

This study presents the largest documented series of patients with invasive mucormycosis presenting as frontal osteomyelitis or Pott's Puffy tumour. A high index of suspicion is warranted in patients with covid-19 associated mucormycosis who present with a forehead swelling because even though PPT is a rare clinical entity it is associated with potentially life-threatening complications. Management is similar to PPT arising in the setting of bacterial sinusitis; broad-spectrum antibiotic coverage in addition to antifungals being essential in preventing further spread and worsening. Cases that do not improve with medical management alone require surgical drainage either endoscopically or through an external approach or a combination of the two, depending on the extent of the disease process.

References

1. Joo MJ, Schapira KE. Pott's Puffy Tumor: A Potentially Deadly Complication of Sinusitis. Cureus. 2019 Dec 11;11(12):e6351. doi: 10.7759/cureus.6351. PMID: 31938637; PMCID: PMC6952032
2. Goldberg AN, Oroszlan G, Anderson TD. Complications of frontal sinusitis and their management. Otolaryngol Clin North Am. 2001 Feb;34(1):211-25. doi: 10.1016/s0030-6665(05)70307-8. PMID: 11344074
3. Tattersall R, Tattersall R. Pott's puffy tumour. Lancet. 2002 Mar 23;359(9311):1060-3. doi: 10.1016/S0140-6736(02)08098-4. PMID: 11937203
4. Grewal HS, Dangaych NS, Esposito A. A tumor that is not a tumor but it sure can kill! Am J Case Rep. 2012;13:133-6. doi: 10.12659/AJCR.883236. Epub 2012 Jul 2. PMID: 23569509; PMCID: PMC3615908
5. Feldman BA, Feldman DE. The nose and sinuses. In: Lee KJ, ed. Essential Otolaryngology, 6th edn. Connecticut: Appleton & Lange, 1995;746 8
6. Blumfield E, Misra M. Pott's puffy tumor, intracranial, and orbital complications as the initial presentation of sinusitis in healthy adolescents, a case series. Emerg Radiol. 2011 Jun;18(3):203-10. doi: 10.1007/s10140-010-0934-3. Epub 2011 Mar 5. PMID: 21380513
7. Osei-Yeboah C, Neequaye J, Bulley H, Darkwa A. Osteomyelitis of the frontal bone. Ghana Med J. 2007 Jun;41(2):88-90. doi: 10.4314/gmj.v41i2.55309. PMID: 17925849; PMCID: PMC1976301
8. Thomas JN, Nel JR. Acute spreading osteomyelitis of the skull complicating frontal sinusitis. J Laryngol Otol. 1977 Jan;91(1):55-62. doi: 10.1017/s0022215100083341. PMID: 833490
9. Raja V, Low C, Sastry A, Moriarty B. Pott's puffy tumor following an insect bite. J Postgrad Med. 2007;53(2):114–16
10. Kühn JP, Linsler S, Nourkami-Tutdibi N, Meyer S, Becker SL, Yilmaz U, Schick B, Bozzato A, Kulas P. Pott's puffy tumor: a need for interdisciplinary diagnosis and treatment. HNO. 2022 Feb;70(Suppl 1):8-13. doi: 10.1007/s00106-021-01134-w. Epub 2022 Jan 24. PMID: 35072731; PMCID: PMC8837573
11. Akiyama K, Karaki M, Mori N. Evaluation of adult Pott's puffy tumor: our five cases and 27 literature cases. Laryngoscope. 2012 Nov;122(11):2382-8. doi: 10.1002/lary.23490. Epub 2012 Aug 2. PMID: 22865613
12. Weinberg B, Gupta S, Thomas MJ, Stern H. Pott's puffy tumor: Sonographic diagnosis. J Clin Ultrasound. 2005 Jul-Aug;33(6):305-7. doi: 10.1002/jcu.20130. PMID: 16134159
13. Gillespie MB, O'Malley BW. An algorithmic approach to the diagnosis and management of invasive fungal rhinosinusitis in the immunocompromised patient. Otolaryngol Clin North Am. 2000 Apr;33(2):323-34. doi: 10.1016/s0030-6665(00)80008-0. PMID: 10736407
14. Patel A, Agarwal R, Rudramurthy SM, Shevkani M, Xess I, Sharma R, et al. Multicenter Epidemiologic Study of Coronavirus Disease–Associated Mucormycosis, India. Emerg Infect Dis. 2021;27(9):2349-2359. https://doi.org/10.3201/eid2709.210934

15. J Peter Donnelly, Sharon C Chen, Carol A Kauffman, William J Steinbach, John W Baddley, Paul E Verweij etal. Revision and Update of the Consensus Definitions of Invasive Fungal Disease From the European Organization for Research and Treatment of Cancer and the Mycoses Study Group Education and Research Consortium, *Clinical Infectious Diseases*, Volume 71, Issue 6, 15 September 2020, Pages 1367–1376, https://doi.org/10.1093/cid/ciz1008
16. Spellberg B, Walsh TJ, Kontoyiannis DP, Edwards J Jr, Ibrahim AS. Recent advances in the management of mucormycosis: from bench to bedside. Clin Infect Dis. 2009 Jun 15;48(12):1743-51. doi: 10.1086/599105. PMID: 19435437; PMCID: PMC2809216
17. Gaillard F, Bell D, Vadera S, et al. Pott puffy tumor. Reference article, Radiopaedia.org (Accessed on 21 Nov 2022) https://doi.org/10.53347/rID-4895
18. Effat KG, Karam M, El-Kabani A. Pott's puffy tumour caused by mucormycosis. J Laryngol Otol. 2005 Aug;119(8):643-5. doi: 10.1258/0022215054516304. PMID: 16102223
19. Verma A, Singh V, Jindal N, Yadav S. Necrosis of maxilla, nasal, and frontal bone secondary to extensive rhino-cerebral mucormycosis. Natl J Maxillofac Surg. 2013 Jul;4(2):249-51. doi: 10.4103/0975-5950.127663. PMID: 24665188; PMCID: PMC3961907
20. Sahoo NK, Kulkarni V, Bhandari AK, Kumar A. Mucormycosis of the Frontal Sinus: A Rare Case Report and Review. Ann Maxillofac Surg. 2017 Jan-Jun;7(1):120-123. doi: 10.4103/ams.ams_23_16. PMID: 28713749; PMCID: PMC5502498
21. Sideris G, Delides A, Proikas K, Papadimitriou N. Pott Puffy Tumor in Adults: The Ôiming of Surgical Éntervention. Cureus. 2020 Nov 30;12(11):e11781. doi: 10.7759/cureus.11781. PMID: 33409028; PMCID: PMC7779183.