Contents lists available at ScienceDirect

## IDCases

journal homepage: www.elsevier.com/locate/idcr

# Pott's puffy tumor caused by Actinomyces naeslundii

## Holly Bean, Zaw Min, James Como, Nitin Bhanot\*

Division of Infectious Disease, Allegheny Health Network, PA, 15212, United States

## ARTICLE INFO

Article history: Received 1 July 2020 Received in revised form 24 September 2020 Accepted 24 September 2020

*Keywords:* Pott's puffy tumor Actinomycosis

## ABSTRACT

Pott's puffy tumor is characterized by forehead swelling from subperiosteal abscess and frontal bone osteomyelitis. It is encountered mainly in children; rarely in adults. When it does occur in the latter population, the most common risk factors include head trauma, sinusitis, or cocaine abuse. Generally, the organisms thought to be involved include streptococci, staphylococci and oral anaerobic flora. We present a case of a 53 year old female who presented with forehead swelling of 3 month duration after a dental procedure, found to be secondary to *Actinomyces naeslundii*. Actinomyces is a very rare etiology of this disease and has been reported only twice earlier in the literature. We present an uncommon infectious disease along with summary of clinical characteristics of this entity in the adult population. © 2020 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Introduction

Pott's Puffy Tumor (PPT) is a clinical diagnosis of a subperiosteal abscess and osteomyelitis of the frontal bone [1]. It is encountered mainly in children, and rarely seen in adults [1]. When it does occur in the latter population, the most common risk factors include head trauma, sinusitis, or cocaine abuse [1]. Complications from PPT include meningitis, epidural empyema, frontal lobe abscess, and cavernous sinus thrombosis; hence the need for prompt diagnosis and aggressive treatment [1].

### **Case report**

A 53 year-old Caucasian female with history of sleep apnea and acid reflux presented with gradual swelling of her forehead for 3 months. She denied having any history of chronic sinusitis or illicit drug use. She did smoke tobacco, 1 pack per day for 30 years. About 6 months prior to presentation, the patient had undergone a tooth extraction; shortly thereafter that she developed symptoms of sinus pressure and congestion. She was initially treated with multiple courses of antimicrobials and steroids for presumed sinusitis without improvement. About three weeks prior to presenting, the patient underwent sinus surgery and was placed on oral levofloxacin for five days. No cultures were obtained at that time. About a week after surgery, the patient started to develop fevers, chills and worsening headache. She reported that while she did have forehead swelling prior to surgery on her sinuses, it became much more pronounced post-operatively. Three weeks after surgery the patient had a CT head that revealed a peripherally enhancing fluid collection measuring 3.1 cm  $\times$  5.9 cm along the right frontal scalp in close proximity to the frontal sinuses and enhancement of the frontal subdural space. MRI head confirmed the findings (Fig. 1). The patient underwent surgical debridement of the abscess with frontal sinus trephination. Cultures were obtained, which grew *Actinomyces naeslundi*. Due to history of being allergic to penicillin the patient was treated with intravenous (IV) ceftriaxone for 9 weeks and then transitioned to oral doxycycline for a total of 6 months of therapy. At 6 month follow up, her symptoms and radiological abnormalities had resolved.

## Discussion

Subperiosteal abscess and frontal bone osteomyelitis, also known as Pott's Puffy Tumor (PPT) was first described by Sir Percival Pott in 1768 in association with head trauma and sinusitis [2]. It occurs as the result of infection traversing through the venous drainage of the frontal sinus or due to direct inoculation to the frontal bone [3]. In order to better understand the clinical characteristics of this disease in the adult population, we reviewed case reports (a total of 47 cases, Table 1) of PPT in adults to determine common risk factors, microbial involvement, management, and outcome of this relatively rare condition. The details are tabulated, and some salient features are described here. With regards to precipitating or underlying risk factors, chronic sinusitis, penetrating defects (either through trauma or

https://doi.org/10.1016/j.idcr.2020.e00974

2214-2509/© 2020 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).



Case report





<sup>\*</sup> Corresponding author at: Division of Infectious Disease, Allegheny General Hospital, 420 East North ave, Allegheny Health Network, Pittsburgh, PA, 15212, United States.

E-mail address: nitin.bhanot@ahn.org (N. Bhanot).

## Table 1

Clinical characteristics of adult patients with Pott's puffy tumor.

Ref No.	Sex	Age	Past medical history	Precipitating cause	Duration of onset	Organism	Antibiotic	Outcome
6]	М	49	No prior history	Insect bite	1 wk	Staph aureus	Flucloxacillin, fusidic acid, metronidazole for 6 weeks	Resolved at 6 weeks
7]	F	55	No prior history	Prior surgical history along the frontal bone 8 yr ago	2 mo	Staph aureus	Antibiotic NR, treated for 8 weeks	NR
8]	М	55	Alcoholism, cirrhosis, epilepsy, tobacco abuse, HTN	Prior history of sinus surgery	1 mo	Viridans group strep	Vancomycin and clindamycin, unknown duration	Patient lost to follow u
€]	F	54	Cocaine/heroin, tobacco abuse, hepatitis C	Trauma to forehead	1 mo	Coagulase negative Staphylococci and beta- hemolytic Streptococci	2.4 million units of benzathine penicillin; 2 IM injections	Resolution by day 5
0]	М	25	Allergic rhinitis and asthma	No known cause	3 wk	Staph aureus	Ceftriaxone 2 g IV daily and then switched to PO antibiotics for 8 weeks (did not specify antibiotic)	Resolved at 6 month follow up
1]	М	33	No prior medical history	No known cause	5 mo	Staph aureus, Peptostreptococcus, S. pneumoniae, H. influenzae	Ceftriaxone 2 g Q 12 h and metronidazole for 2 weeks, followed by oral metronidazole and amoxicillin- clavulanate for 4 weeks	No recurrence for 7 yr
12]	М	NR	Hx of headaches and recurrent abscesses along the frontal soft tissue	No known cause	Not known	Strep anginosus	Moxifloxacin and metronidazole for 3 months	NR
13]	М	41	Chronic sinusitis, tobacco use, cocaine use	No known cause	26 days	Strep intermedius	Ceftriaxone and metronidazole, unknown duration	NR
4]	М	37	Chronic exophthalmia	No known cause	2 yr	Mycoplasma	Doxycycline, unknown duration	Symptoms resolved at months
5]	М	46	No prior medical history	No known cause	6 mo	No organism identified by culture	NR	Recurred twice and required second I&D
16] 16]	M M	26 34	No prior medical history No prior medical history	No known cause Cocaine use	2 mo 6 wk	H. influenzae B. melaninogenicus, Fusobacterium, Propionibacterium, group A Strep	antibiotic NR - for 5 weeks IV ampicillin/sulbactam 2 wks then oral amoxicillin/clavulaunate for 4 wks	resolved NR
6]	F	54	No prior medical history	No known cause	Not known	No organism isolated	PO amox/clav and cloxacillin for 1 mo, PO penicillin for 1 mo	resolved
6]	М	83	Unknown	Head trauma	4 yr	H. influenzae	Ceftriaxone for 2 weeks followed by cefprozil for 4 week	No recurrence for 1 yr u
7]	М	74	Unknown	Scalp injections for hair loss	2 mo	Staph aureus	IV nafcillin 1 mo, Po dicloxacillin 4 weeks	resolved
8]	М	21	No prior medical history	Dental sepsis	3 wk	Streptococcus intermedius, Bacteroides melaninogenicus	4 weeks of IV ampicillin	resolved
9]	М	53	None	Head trauma	3 wk	Streptococcus milleri	Unknown	Died 5 days after admission
0]	М	39	None	No known cause	3 mo	Streptococcus milleri	IV benzyl penicillin for 3 weeks followed by amoxicillin for 3 weeks	resolved
1]	F	67	None	No known cause	Not known	Pseudomonas aeruginosa	Unknown	NR
2] 3]	M M	58 27	Diabetes mellitus Diabetes mellitus	Head trauma Head trauma 13 yrs	2 mo 3 wk	No organism isolated Staph aureus	Cefuroxime, unknown duration NR	No recurrence Unknown
4]	М	35	No prior medical problems	prior No known cause	9 mo	Aspergillus flavus	NR	No recurrence at 3 m
5] 6]	F M	62 54	Diabetes, CKD, HTN Hx of frontal bone reconstruction 30 yrs prior	No known cause URI- cold virus	1 wk 15 days	mucormycosis No organism isolated	Amphotericin B for 3 weeks Ampicillin/sulbactam for 10 days followed by amoxicillin/clavulanate for	f/u No recurrence Did well at 24 month follow up
]	М	37	No prior medical history	No known cause	1 mo	unknown	15 days Unknown	No recurrence

2

11     M     38     No prior medical history     No known cause     1 mo     unknown     Unknown     No recurrence       11     M     38     History of crasiplesty for patialary tunior     No known cause     2 days     Prepriorationals introduction     Unknown     No recurrence       11     M     38     History of crasiplesty for patialary tunior     No known cause     2 days     Prepriorationals introduction     Unknown     No recurrence       121     F     21     No prior medical history     No known cause     2 yr     unknown     Unknown     No known       123     M     37     No prior medical history     No known cause     2 yr     unknown     Unknown     No known       123     M     60     HTNL DM     No known cause     8 wks     Strep unilleri     Angolubactin     Amgolubactin     No known     Record af on of follow       129     F     41     thinoinsuitis     No known cause     8 wks     Strep unilleri     Angolubactin     Angolubactin     Record af on of follow       130     H     60     thinoinsuitis     No known cause     8 wks     Strep unilleri     Angolubactin     Angolubactin     Record af on of Angolubactin     Angolubactin     Angolubactin     Angolubactin     No kocaud     Angolubac									
InterpretationMatrix Provedia ordis, Fundamental Fundamental Fundamental Fundamental Fundamental Fundamental Fundamental Fundamental Fundamental Fundamental Fundamental Fundamental Fundamental Fundamental 									
11     M     N     No     No known cause     2 days     Preveloal criming information in the i	[1]	M	76	Aplastic anemia, Diabetes	No known cause	2 wk		Unknown	No Recurrence
Image: Participation of the second							Micromonas micros		
11NoSetNoNo known cause nor known not known known not known<	[1]	Μ	38	History of cranioplasty for	No known cause	2 days	Prevotella oralis,	Unknown	Had recurrence
11     M     28     No prior medical history     No known cause not known     2 yr or primer     Unknown     Unknown     No prior medical history     No known cause not known     Strep milleri     Unknown     Cefriasone of 3 weeks, oral amoticilin/clavulante for 4 weeks up     Resolved at 6 mo follow up       [23]     M     60     HTN, DM     No known cause     8 wks     Strep anginosus     Cefriasone and metronidazole for 6 weeks     2 wk     Resolved at 6 mo follow up       [30]     M     60     HTN, DM     No known cause     8 wks     Strep anginosus     Cefriasone and metronidazole for 6 weeks     2 wk     Resolved at 6 mo follow up       [30]     M     60     Hinosinusitis     No known cause     not known     Petotsus     Amgistubactam, anomycin, betosis     Resolved at 6 mo follow up       [30]     M     24     Rhinosinusitis     No known cause     Proteus     andipstubactam, anomycin, known     Resolved at 3 months nettinycin       [31]     M     52     sinusitis     No known cause     4 yr     Stop and cogulas engative stop and cogulas e				pituitary tumor			Fusobacterium, Micromonas		requiring further
11     M     28     No prior medical history     No known cause not known     2 yr or primer     Unknown     Unknown     No prior medical history     No known cause not known     Strep milleri     Unknown     Cefriasone of 3 weeks, oral amoticilin/clavulante for 4 weeks up     Resolved at 6 mo follow up       [23]     M     60     HTN, DM     No known cause     8 wks     Strep anginosus     Cefriasone and metronidazole for 6 weeks     2 wk     Resolved at 6 mo follow up       [30]     M     60     HTN, DM     No known cause     8 wks     Strep anginosus     Cefriasone and metronidazole for 6 weeks     2 wk     Resolved at 6 mo follow up       [30]     M     60     Hinosinusitis     No known cause     not known     Petotsus     Amgistubactam, anomycin, betosis     Resolved at 6 mo follow up       [30]     M     24     Rhinosinusitis     No known cause     Proteus     andipstubactam, anomycin, known     Resolved at 3 months nettinycin       [31]     M     52     sinusitis     No known cause     4 yr     Stop and cogulas engative stop and cogulas e							micros		surgical intervention
127     F     21     Pregnancy     No known cause     not known     Strep anginositie     IV ceffixione for 3 weeks, oral anoscillificatiounant for 4 weeks     Resolved a 6 mollow up       128     M     37     No prior medical history     Taumatic head hijuyy     1 mo     No growth     Ceffriaone and metronidazole for 6 weeks     Resolved a 6 mollow up       129     M     60     HTN, DM     No known cause     8 wks     Strep anginosus     Ceffriaone and metronidazole for 6 wks     2 wk fu sweling       130     F     41     thinosinusitis     No known cause     No known cause     Proteus     AmpSubactam, vanconycin, metropenen, netimerin     Resolved a 6 mollow up       130     M     60     rhinosinusitis     No known cause     Proteus     No known     AmpSubactam, vanconycin, metropenen, netimerin     Resolved a 6 mol 4 - 8 weeks       130     M     24     Rhinosinusitis,     No known cause     1 month     No growth     Proteus     AmpSubactam, metropenen, netilingrin     Resolved a 3 months       131     M     56     sinusitis     Taumatic injury     1 month     No growth     Y antibiotis for 1 month, type NR     Drain renoved and had full recovery at 3 months       132     F     52     NR     No known cause     4 yr     MSSA and Cagulase negatie     A third generation cephalos	[1]	М	28	No prior medical history	No known cause	2 vr	unknown	Unknown	
128M37No prior medical historyTraumatic head injury1 moNo growthCiprofloacain 3 weeksResolved at 6 mo follow up129M60HTN. DMNo known cause8 wksStrep anginosusCeftriaxone and metronidazole for 6 wks2 wkfru sveling resolved at 6 mo follow up130K41rhinosinusitisNo known causenot knownPeptostreptococcus constellatus Streptococcus constellatusCeftriaxone and metronidazole for 6 wksResolved at 6 mo130K20rhinosinusitisNo known causeProteusAmpisulbactam, vancomycin, meropenem, netilmycinResolved at 6 mo130K20rhinosinusitisNo known causeImnownAmpisulbactam, vancomycin, Armpisulbactam, meropenem, constraintsResolved at 6 mo130K26sinusitisNo known causeImnownAmpisulbactam, meropenem, constraintsResolved at 3 months131M56sinusitisTraumatic injuryI monthNo growthIV antibiotics for 1 month, type NR stoppicocciPrain removed and had fail removed and had fail removed at 12 monthPrain removed and had fail monthNo known cause4 yr132F62No prior medical problemsNo known cause4 yrMSA and Coagulase negativ Staph/cocciA third generation rephalosponin follow upNo tecnory at 3 month follow up132F62No prior medical problemsNo known cause4 yrMSA and Coagulase negativ Staph/cocciA				1 5					
Image: Probability of the second s	()							·····	
[29]M60ITR, DMNo known cause8 wksStrep anginosusCeftriasone and metronidazole for 6 wksywk fur swelling resolved[30]F41rhinosinusitisNo known causenot knownPeptostreptocaccus prevoti, streptocaccus constellatusAmp/sublactan, vancomycin, meropenem, netlinycinResolved at 6 mo[30]M60rhinosinusitisNo known causeProtessAmp/sublactanResolved at 6 mo[30]+27rhinosinusitisNo known causeunknownAmp/sublactanResolved at 3 months[31]M56sinusitisTaumatic injury1 monthNo growthMitoria for 1 month, type NRPrain removed and had months follow up[31]M56sinusitisTaumatic injury1 monthNo growthA third generation cephalosporin, curation NRPrain removed and had bitis, streptocaccusPrain removed and had bitis, streptocaccusA third generation cephalosporin, unknown RPrain removed and had bitis, streptocaccusA third generation cephalosporin, unknown RPrain removed and had bitis, streptocaccusResolved at 2 month follow up[33]F62No prior medical problemsNo known cause6 moProtellaCindany of weeks bitis, streptocaccus trainermediusResolved at 6 month follow up[34]M21sinsistisTeeth extractions3 wkEikenella corridens, PrevetellaCindany of morth for 0 weeks trainermediusResolved at 6 month follow up[35]	[28]	м	37	No prior medical history	Traumatic head injury		No growth	1	Resolved at 6 mo follow
[29]       M       60       HTN, DM       No known cause       8 wks       Strep anginosus       Ceftriaxone and metronidazole for 6 resolved       2 wk fu swelling resolved         [30]       F       41       hinosinusitis       No known cause       pot of known       Peptostreptococcus prevoli, Streptococcus consentiatus       Amp/sulbactam, vancomycin, Ero 4-8 weeks       Mamp/sulbactam, vancomycin, erosolved       Pestostreptococcus prevoli, Streptococcus consentiatus       Amp/sulbactam, vancomycin, erosolved       Resolved at 6 mo         [30]       +       2.7       hinosinusitis       No known cause       -       Protus       Amp/sulbactam, neropenem, angelinysubatam, neropenem, erosolved       Resolved at 3 months         [31]       M       56       sinusitis       No known cause       4 yr       MSA and Coagulate negative Staphylococci       Athing generation cephalosporin, duration NR       Prain removed and had full recovery at 3 months         [32]       F       72       NR       No known cause       4 yr       MSA and Coagulate negative Staphylococci       A thind generation cephalosporin, metronidazole for 6 weeks       No recoverace and year follow up         [33]       F       62       No prior medical problems       No known cause       3 wk       Elevella corrodens, Prevotella bivis, streptococci       Athind generation cephalosporin, metronidazole for 6 weeks       Resolved at 1 mont	[20]		57	no phot medical mistory	fraumatic fieur injury	T IIIO	no giowin	elpronoxuelli 5 weeks	
130F41rhinosinusitisNo known cause knownnot knownPeptotreptocccus prevolit. Streptococcus constellatuswisreader abceased130M60rhinosinusitisNo known causeproteusProteusAmp/sulbactam, anconycin, amp/sulbactam, anconycin, and anconycin, and anconycin, and anconycin, and anconycin, and anconycin, an	[20]	М	60		No known causo	9 who	Strop anginosus	Coffriavana and matronidazala for 6	
Image: Probability of the section of the sectin of the section of the section of	[29]	IVI	60	HIN, DW	NO KIIOWII CAUSE	o wks	Strep anginosus		1 0
Image: Strept on the strept	[20]	г	41	-	No lunouum onuoo		Dente strents as save manuati:		
[30]M60rhinosinusitisNo known causeProteusProteusAmpfollbactamResolved at 6 mo 4-8 weeks[30]+27rhinosinusitisNo known causeunknownAmpfollbactamResolved at 3 months[30]M24Rhinosinusitis,No known causeE. coli an staph aureusAmpfollbactam, meropenen, netilnycinResolved at 3 months[31]M56sinusitisTraumatic injury1 monthNo growthIV antibiotics for 1 month, type NRPrain removed and had full recovery at 3 months follow up[32]F72NRNo known cause4 yrMSA and Caagulase negative StaphylococciA third generation cephalosporin, duration NRNo known causeM yr[33]F62No prior medical problemsNo known cause6 moPrevotelaClindamycin for 2 weeks, erapenen + metronikazole for 4Resolved at 6 month full weight[34]M21sinusitisTeeth extractions3 wkEikenella corroders, PrevotelaNo knownResolved at 6 month follow up[35]M29nonetrauma5 yr after surgeryStaph aureusLevofloxacin, duration NRResolved at 6 month follow up[36]M27nonePor dentitionunknownunknownUnknownUnknownUnknown[37]M61nonePrior hx of Potfy guffy5 dayUnknownCo-amoxicla, unknown duration full weeks follow upUnknown[38]M63<	[30]	F	41	rninosinusitis	No known cause				Deceased
I 20M60InitiosinusitisNo known causeProfeusAmpfoulbactam 4-8 verdes 4-8 verdes 4-8 verdesResolved at 6 mo[30]M24RhinosinusitisNo known causeE coli and staph aureusAmpfoulbactam, meropenem, netilingvin 6 weeksResolved at 3 months[31]M56sinusitisTaumatic injury1 monthNo growthAntifotio Sr 1 month, type NRParlamenova and antifishci[32]F72NRNo known cause4 yrMSSA and Coagulase negative StaphylocociAthird generation rephalosporin, ourth StaphylocociAthird generation rephalosporin, anoth StaphylocociAthird generation rephalosporin, anoth StaphylocociResolved at 3 months anoth Staphylococi[32]F62No prior medical problemsNo known cause4 yrMSSA and Coagulase negative staphylocociAthird generation cephalosporin, anoth StaphylocociNo known cause6 mon[34]M21sinusitisTeeth extractions3 wkEikenella corrodens, Prevolela tatem setup staph aureusNo tanown duration unknown durationResolved at 2 months recurrent at month staph aureusNo known cause5 yr after surgery recurrent at month staph aureusNo known recurrent at month staph aureusNo knownNo known recurrent at month staph aureus <td< td=""><td></td><td></td><td></td><td></td><td></td><td>known</td><td>Streptococcus constellatus</td><td>1 . 5</td><td></td></td<>						known	Streptococcus constellatus	1 . 5	
301       +       27       rhinosinusitis       No known cause       unknown       Amny subbactam       Resolved         301       M       24       Rhinosinusitis,       No known cause       E. coli and staph aureus       Amny subbactam, meropenem, netlinyvin 6 vereks       Resolved at 3 months netlinyvin 6 vereks         311       M       56       sinusitis,       Traumatic injury       1 month       No growth       V antibiotics for 1 month, type NR       Drain removed and had full recovery at 3 months 6 wereks         312       F       72       NR       No known cause       4 yr       MSSA and Cagulase negative Staphylococci       Athird generation cephalosporin, duration NR       verefield at 2 month full recovery at 3 months 6 low up         313       F       62       No prior medical problems       No known cause       6 mo       Prevotella       Cindamycin for 2 weeks, ertapenem + metonidazole for 6 weeks and then cindamycin for a metonidazole for 6 weeks and then cindamycin for a metonidazole for 6 weeks       Resolved at 12 month bivia, streproceccus unteredus unknown duration unknown duration unteromidazole for 6 weeks       Resolved at 6 month follow up         351       M       21       none       Poor denition       unknown       unknown       unknown       unknown         361       M       27       none       Poor denition       unknown       unk									
[30]*27rhinosinusitisNo known causeunknownAmp/subactam 4-8 weeks amp/subactam, meropenem, netilnycia 6 weeksResolved at 3 months full recovery at 3 months follow up[31]M56sinusitis,No known cause4 yrMSSA and Coagulase negative staphylococciA third generation cephalosporin, duration NRPatientem cephalosporin, months follow upNo known cause4 yrMSSA and Coagulase negative staphylococciA third generation cephalosporin, duration NRNo known cause6 noNo known causeA prevelse staphylococciA third generation cephalosporin, duration NRNo known cause6 noNo known causeA prevelse staphylococciA third generation cephalosporin, duration NRNo known cause6 noNo known causeA prevelse staphylococci intermediusA third generation cephalosporin, duration NRNo known causeA prevelse staphylococci intermediusA third generation cephalosporin, duration NRNo known causeA prevelse staphylococci intermediusA prevelse staphylococci intermediusA coused at 2 month staphylococci intermediusRefued surgery, recurred after 2 months recurred after 2 months recurred after 2 months unknownRefued surgery, recurred without surgici intervention surgici interventionNo known causeA who A staph areusIndenovaNo known causedNo known causedNo known causedNo known causedNo known causedNo known causedNo known causedNo known causedNo known causedNo known cau	[30]	М	60	rhinosinusitis	No known cause		Proteus		Resolved at 6 mo
[30]       M       24       Rhinosinusitis,       No known cause       E. coli and staph aureus       4-3 weeks netilinycin 6 weeks       Resolved at 3 months of weeks         [31]       M       56       sinusitis       Traumatic injury       1 month       No growth       Participation       Resolved at 3 months of weeks         [32]       F       72       NR       No known cause       4 yr       MSSA and Coagulas negative Staphylococci       A third generation cephalosporin, duration NR       Participation       No recurrence at one year follow up         [33]       F       62       No prior medical problems       No known cause       6 mo       Prevotella       A third generation cephalosporin, duration NR       Participation       No scower at a months staphylococci       A third generation cephalosporin, weeks, then PO moxifloxacin for 4       Resolved at 12 month follow up         [34]       M       21       sinusitis       Teeth extractions       3 wk       Elkenella corrodens, Prevotella bivia, streptococcus unknown duration       Wanomycautaio NR       Resolved at 2 month follow up         [35]       M       27       none       Poor dentition       unknown       unknown       unknown       Moorn         [36]       M       27       none       Poor dentition       unknown       unknown       O-amoxiclav, unkno								4–8 weeks	
[30]M24Rhinosinusitis, netilinycin of weeksNo known causeE. coli and staph aureusAmp/sublactam, meropenem, netilinycin of weeksResolved at 3 months netilinycin of weeks[31]M56sinusitisTraumatic injury1 monthNo growthV antibiotics for 1 month, type NRPrain meropenem, netilinycin follow up[32]F72NRNo known cause4 yrMSSA and Coagulase negative StaphylococciA third generation cephalosporin, duration NRResolved at 2 month staphylococci[33]F62No prior medical problemsNo known cause4 yrMSSA and Coagulase negative staphylococciA third generation cephalosporin, duration NRResolved at 2 month follow up[34]M21sinusitisTeeth extractions3 wkEikenella corrodens, Prevotella intermediusWaroomcin and metronidazole for 4 weeks, then PO moxifloxacin for unknown duration NRResolved at 6 month follow up[35]M23nonePoor dentitionunknownunknownunknown duration staph aureusResolved at 6 month weeks, then PO moxifloxacin for unterorred after 2 months follow up[37]M61nonePoor dentitionunknownunknownunknownBroad spectrum abx for 6 weeks surgical intervention surgical intervention surgical interventionNo known cause2 wkStrep milleri Pasteurella multocidaCo-amoxiclaw, unknown duration No known cause2 wkStrep milleri Pasteurella multocidaCo-amoxiclaw, unknown dur	[30]	+	27	rhinosinusitis	No known cause		unknown	Amp/sulbactam	Resolved
[31]M56sinusitisTraumatic injury1 monthNo growthIV antibiotics for 1 month, type NR built ecovery at 3 months follow upDrain removed and had full recovery at 3 months follow up[32]F72NRNo known cause4 yrMSSA and Coagulase negative StaphylococciA third generation cephalosporin, duration NRNo recurrence at one yclication for 2 weeks, ertapenem + Resolved at 12 month[33]F62No prior medical problemsNo known cause6 moPrevotellaClindamycin for 2 weeks, ertapenem + clindamycin for another 6 weeksResolved at 12 month follow up[34]M29nonetreeth extractions3 wkEikenella corrodens, PrevotellaWanowni duration NRResolved at 6 month follow up[35]M29nonetrauma5 yr after surgery No known causeStaph aureusLevofloxacin, duration NRRefused surgery, recurred after 2 months follow up[36]M27nonePoor dentitionunknownunknownUnknownUnknownUnknown[37]M61nonePrior hx of Pott's puffy No known cause5 dayUnknownUnknownUnknownUnknown[38]M79HTN, prostate cancer, CKDNo known cause2 wkStrep milleri S moCo-amoxiclav, unknown duration V ceforaxine and PO poincillin for S moUnknownUnknown[4]M79HTN, prostate cancer, CKDNo known cause1 moActinomycesAntibiotics for 6 mo								4–8 weeks	
[31]M56sinustisTraumatic injuryI monthNo growthPrevention6 weeks Maribiotics for 1 month, type NRDrain renoved and had full recovery at 3 month[32]F72NRNo known cause4 yrMSSA and Coagulase negative StaphylococciA third generation cephalosporin, duration NRNo recurrence at 4 generation cephalosporin, duration NRNo recurrence at 4 generation cephalosporin, duration NRA third generation cephalosporin, duration NRNo recurrence at 4 generation cephalosporin, duration NRA third generation cephalosporin, duration NRNo recurrence at 4 generation cephalosporin, duration NRNo recurrence at 4 generation cephalosporin, duration NRA third generation cephalosporin, duration NRNo recurrence at 12 month[34]F62No prior medical problemsTeeth extractions3 wkEikenella corrodens, Prevotella bivia, streptococcus in unknown durationNo selved at 6 month powers, teer PO moxifloxacin for unknown durationResolved at 6 month recurrend ater 2 months recurrend ater 2 m	[30]	Μ	24	Rhinosinusitis,	No known cause		E. coli and staph aureus	Amp/sulbactam, meropenem,	Resolved at 3 months
[31]M56sinustisTraumatic injuryI monthNo growthPrevention6 weeks Maribiotics for 1 month, type NRDrain renoved and had full recovery at 3 month[32]F72NRNo known cause4 yrMSSA and Coagulase negative StaphylococciA third generation cephalosporin, duration NRNo recurrence at 4 generation cephalosporin, duration NRNo recurrence at 4 generation cephalosporin, duration NRA third generation cephalosporin, duration NRNo recurrence at 4 generation cephalosporin, duration NRA third generation cephalosporin, duration NRNo recurrence at 4 generation cephalosporin, duration NRNo recurrence at 4 generation cephalosporin, duration NRA third generation cephalosporin, duration NRNo recurrence at 12 month[34]F62No prior medical problemsTeeth extractions3 wkEikenella corrodens, Prevotella bivia, streptococcus in unknown durationNo selved at 6 month powers, teer PO moxifloxacin for unknown durationResolved at 6 month recurrend ater 2 months recurrend ater 2 m							-	netilmycin	
[31]MS6sinusitisTraumatic injury1 monthNo growthNo growthIV antibiotics for 1 month, type NR and the full recovery at 3 month Sollow upDrain removed and bad full recovery at 3 month Sollow up[32]F72NRNo known cause4 yrMSSA and Coagulase negative StaphylococciA third generation RR ataphylococciNo recurrence are op year[33]F62No prior medical problemsNo known cause6 moPrevotellaClindamycin for 2 weeks, ertapenen + clindamycin for a nother 6 weeksResolved at 12 month follow up[34]M21sinusitisTeeth extractions3 wkEikenella corrodens, Prevotella intermediusIV vancomycin and metronidazole for 4 weeks, the PD moxillokaccin for unknown durationResolved at 12 month recurred after 2 months weeks, the PD moxillokaccin for unknown durationResolved at 20 month entromedius[35]M29nonetrauma5 yr after surgery strafter surgeryStaph aureusLevofloxacin, duration NR unknownRefused surgery, recurred after 2 months unknown[36]M27nonePoor dentitionNo known ouse2 wkStrep milleri Pasteurella multocidaCo-amoxiclav, unknown duration to V ceforaxime and PO clindamycin for anoticle for 6 weeksUnknown[37]M63Chronic rhinosinusitisNo known cause2 wkStrep milleri Pasteurella multocidaCo-amoxiclav, unknown duration to V ceforaxime and PO clindamycin for anoticle for 6 months; po course with amoxicilli								6 weeks	
[32]F72NRNo known cause4 yrMSSA and Coagulase negative StaphylococciA third generation cephalosporin, duration NRNo known ceurence at one year follow up[33]F62No prior medical problemsNo known cause6 moPrevotellaA third generation cephalosporin, duration NRNo known cause6 moPrevotellaA third generation cephalosporin, duration NRNo known cause6 moPrevotellaA third generation cephalosporin, duration NRNo known cause6 moNo known cause7 moreNo known cause7 moreNo known cause7 moreNo known cause7 moreNo knownNo	[31]	М	56	sinusitis	Traumatic injury	1 month	No growth		Drain removed and had
[32]F72NRNo known cause4 yrMSSA and Coagulase negativ StaphylococciA third generation cephalosporin, duration NRMonths follow up No recurrence at one year follow up[33]F62No prior medical problemsNo known cause6 moPrevotellaClindamycin for 2 weeks, ertapenen + clindamycin for 2 weeks, ertapenen + didadmycin for another 6 weeksResolved at 12 month follow up[34]M21sinusitisTeeth extractions3 wkEikenella corrodens, PrevotellaV vancomycin and metronidazole for 4 weeks, then P moxification for unknown durationResolved at 6 month follow up[35]M29nonetrauma5 yr after surgeryStaph aureusBroad spectrum abx for 6 weeks unknownRefused surgery, recurred after 2 months total tumor 5 mo prior[36]M27nonePoor dentitionunknownunknownUnknownUnknown[37]M61nonePrior hx of Pott's puffy No known cause5 dayUnknownCo-amoxiclav, unknown duration Prevefulla multocidaCo-amoxiclav, unknown duration NV cefotaxime and PO clindamycin for four weeks followed by PO clindamycin for four weeks followed by PO encilillin for debridement 5 months <br< td=""><td>[]</td><td></td><td></td><td></td><td></td><td></td><td></td><td>······································</td><td></td></br<>	[]							······································	
[32]F72NRNo known cause4 yrMSSA and Coagulase negative StaphylococciA third generation cephalosporin, duration NRNo recurrence at one yersofollow up[33]F62No prior medical problemsNo known cause6 moPrevotellaClindamycin for 2 weeks, ertapenen + metroindazole for 6 weeksResolved at 12 month follow up[34]M21sinusitisTeeth extractions3 wkEikenella corrodens, Prevotella intermedius intermediusVI vancomcin and metroindazole for 4 weeks, then PO moxifloxacin for unknown durationResolved at 6 month follow up[35]M29nonetrauma5 yr after surgeryStaph aureusLevofloxacin, duration NRRefused surgery, recurred after 2 months recurred after 2 months follow up[36]M27nonePoor dentitionunknownunknownMunownBroad spectrum abx for 6 weeksRefused surgery, recurred after 2 months surgical intervention surgical intervention[37]M61nonePrior hx of Pott's puffy tumor 5 mo prior5 dayUnknownCo-amoxiclav, unknown duration VIV cefotaxiem and DV clindamycin for urwecks followed by DO penicillin for 5 moNenown[4]M79HTN, prostate cancer, CKDNo known cause1 mohActinomyces, Fusobacterium ProjonibacteriumActinomyces, Fusobacterium straterianAntibiotic vancomycin, ertazinanResolved at 6 mofollow unknown[4]M79HTN, prostate cancer, CKDNo known causeunknown									5
[33]F62No prior medical problemsNo known cause6 moPrevotelladuration NRyear follow up[34]M21sinusitisTeeth extractions3 wkEikanella corrotens, PrevotellaNo known durationResolved at 12 month netronidazole for 6 weeks, erta pameth bivia, streptococcus intermediusVancomycin or avoetks, erta pameth metronidazole for 6 weeks, erta pameth duration NRResolved at 12 month follow up[35]M29nonetrauma5 yr after surgeryStaph aureusLevofloxacin, duration NRRefused surgery, recurred after 2 months recurred after 2 months recurred after 2 months unknownRefused surgery, recurred after 2 months unknown[36]M27nonePoor dentitionunknownunknownUnknownUnknown[37]M61nonePrior hx of Pott's puffy tumor 5 mo prior5 dayUnknownUnknownUnknown[38]F63Chronic rhinosinusitisNo known cause3 wkStrep milleriCo-amoxiclav, unknown duration IV cefotaxime and PO clindamycin for four weeks followed by PO penicillin for four weeks followed by PO penicillin for debridement 5 months later[4]M79HTN, prostate cancer, CKDNo known causeunknown unknownActinomyces, Fusobacterium propionibacteriumAntibiotics for 6 months; po course with amoxilibicit.chavulanateunknown[5]M52noneTrauma1 moActinomyces, Fusobacterium propionibacteriumArtinbiotic vanuomycin, edw	[22]	Б	72	NP	No known causo	4 wr	MSSA and Coagulace pogative	A third generation conhalosporin	· · · · · · · · · · · · · · · · · · ·
[33]F62No prior medical problemsNo known cause6 moPrevotellaClindamycin for 2 weeks, ertapenen + metronidazole for 6 weeks and then noldmycin for a other 6 weeks, and then follow up[34]M21sinusitisTeeth extractions3 wkEikenella corrodens, Prevotella bivia, streptococcus intermediusIV vancomycin and metronidazole for 4 weeks, then PO moxifloxacin for unknown durationResolved at 6 month follow up[35]M29nonetrauma5 yr after surgeryStaph aureusLevofloxacin, duration NRRefused surgery, recurred after 2 months recurred after 2 months surgical intervention[36]M27nonePoor dentitionunknownunknownBroad spectrum abx for 6 weeks unknownRefused surgery, recurred after 2 months surgical intervention[37]M61nonePrior hx of Potr's puffy tumor 5 mo prior5 dayUnknownUnknownUnknown[2]F58Chronic rhinosinusitis S 8No known cause2 wkStrep milleri Pasteurella multocidaCo-amoxiclav, unknown duration IV coftotaire and PO clindamycin for four weeks followed by PO penicillin for 5 moUnknown[4]M79HTN, prostate cancer, CKDNo known causeunknownActinomyces, Fusobacterium, Projonibacterium4 weeks IV antibiotic vancomycin, ether ad after 2 month generation[5]M52noneTrauma1 moActinomyces, Fusobacterium projonibacterium4 weeks IV antibiotic vancomycin, ether ad for 5 mol	[32]	ľ	12	INK	NO KIOWII Cause	4 yi			
[34]M21sinusitisTeeth extractions3 wkEikenella corrodens, Prevotella bivia, streptococcus intermediusmetronidazole for 6 weeks and then clindamycin for another of weeksfollow up[35]M29nonetrauma5 yr after surgeryStaph aureusLevofloxacin, duration NRRefused surgery, recurred after 2 months surgical intervention[36]M27nonePoor dentitionunknownunknownBroad spectrum abx for 6 weeksResolved at 6 month follow u[p[37]M61nonePrior hx of Pott's puffy tumor 5 mo prior5 dayUnknownUnknownUnknownUnknown[38]M63Chronic rhinosinusitisNo known cause2 wkStrep milleri s wkCo-amoxiclav, unknown duration IV cefotaxime and PO clindamycin for four weeks followed by PO penicillin for s moUnknown[4]M79HTN, prostate cancer, CKDNo known causeunknownActinomyces, Fusobacterium, Propionibacterium4 weeks IV antibiotic vancomycin, with amoxicillin-clavulanateResolved at 6 month four weeks followed by PD penicillin for four weeks followed by PD penicillin for s monthInknown[5]M52noneTrauma1 moActinomyces, Fusobacterium, Propionibacterium4 weeks IV antibiotic vancomycin, eetaviliancei; metronidazole; then 4 up	[22]	Б	62	No prior modical problems	No known cauco	6 ma			5
[34]M21sinusitisTeeth extractions3 wkEikenella corrodens, Prevotella bivia, streptococcus intermediusclindamycin for another 6 weeks IV vanconycin and metronidazole for 4 weeks, then PO moxifloxacin for unknown duration Levofloxacin, duration NRResolved at 6 month follow u[p[35]M29nonetrauma5 yr after surgery unknownStaph aureusEikenella corrodens, Prevotella bivia, streptococcus intermediusBroad spectrum abx for 6 weeksResolved at 6 month follow u[p[36]M27nonePoor dentitionunknownunknownBroad spectrum abx for 6 weeksRefused surgery, recurred after 2 months regical intervention[37]M61nonePrior hx of Potr's puffy tumor 5 mo prior tumor 5 mo prior tumor 5 mo prior5 dayUnknownUnknown[38]M63Chronic rhinosinusitis Recurrent sinusitisNo known cause2 wkStrep milleri Pasteurella multocidaCo-amoxiclav, unknown duration IV cefotaxime and PO clindamycin for four weeks followed by PO penicillin for deridement 5 months 5 moUnknown[4]M79HTN, prostate cancer, CKDNo known causeunknownActinomyces, Fusobacterium, PropionibacteriumAntibiotics for 6 months; po course with amoxicillin-clavulanateKesolved at 6 mo follow up[5]M52noneTrauma1 moActinomyces, Fusobacterium, Propionibacterium4 weeks IV antibiotic vancomycin, eeradime, eertroladole; the option up	[55]	Г	02	No prior medical problems	NO KHOWH Cause	6 110	Plevolella		
[34]M21sinusitisTeeth extractions3 wkEikenella corrodens, Prevotella bivia, streptococcus intermediusIV vancomycin and metronidazole for 4 weeks, then PO moxitionResolved at 6 month folow up[35]M29nonetrauma5 yr after surgeryStaph aureusMureusRefused surgery, recurred after 2 months[36]M27nonePoor dentitionunknownunknownBroad spectrum abx for 6 weeksRefused surgery, recurred after 2 months[37]M61nonePrior hx of Pott's puffy tumor 5 mo prior5 dayUnknownUnknownUnknown[38]M63Chronic rhinosinusitis No known cause2 wkStrep milleri y awkCo-amoxiclav, unknown duration IV cefotaxime and PO clindamycin for four weeks followed by Popenicillin of unknownUnknown[4]M79HTN, prostate cancer, CKDNo known causeunknownActinomyces, Fusobacterium, PropionibacteriumActinomyces, Fusobacterium, Propionibacterium4 weeks IV antibiotics for 6 months; po course with amoxify at the metronidazole; then 4 up									follow up
M29nonetrauma5 yr after surgeryStaph aureusweeks, then PO moxifloxacin for unknown durationfollow u[p[36]M27nonetrauma5 yr after surgeryStaph aureusLevofloxacin, duration NRRefused surgery, recurred after 2 months[36]M27nonePoor dentitionunknownunknownunknownBroad spectrum abx for 6 weeksResolved without surgical intervention[37]M61nonePrior hx of Potr's puffy tumor 5 mo prior5 dayUnknownUnknownUnknown[38]M63Chronic rhinosinusitis No known causeNo known cause2 wkStrep milleri Pasteurella multocidaCo-amoxiclav, unknown duration N' ceforatime and PO clindamycin for four weeks followed PO penicillin for 5 moUnknown[4]M79HTN, prostate cancer, CKDNo known causeunknownActinomyces, Fusobacterium, PropionibacteriumA weeks IV antibiotic vancomycin, etarUlanateResolved at 6 mo follow up[5]M52noneTrauma1 moActinomyces, Fusobacterium, Propionibacterium4 weeks IV antibiotic vancomycin, etarUlanateResolved at 6 mo follow up									
[35]M29nonetrauma5 yr after surgeryStaph aureusunknown durationRefused surgery, recurred after 2 months[36]M27nonePoor dentitionunknownunknownunknownBroad spectrum abx for 6 weeksRefused surgery, recurred after 2 months[37]M61nonePrior hx of Pott's puffy tumor 5 mo prior5 dayUnknownUnknownUnknownUnknown[38]M63Chronic rhinosinusitis No known causeNo known cause2 wkStrep milleri Pasteurella multocidaCo-amoxiclav, unknown duration IV cefotaxime and PO clindamycin for four weeks followed by PO penicillin for 5 moRequired further debridement 5 months later[4]M79HTN, prostate cancer, CKDNo known causeunknownActinomyces, Fusobacterium Propionibacterium Propionibacterium4weeks IV antibiotic vancomycin, eeks IV antibiotic vancomycin, eeftazidime, metronidazole; then 4Resolved at 6 mo follow up	[34]	M	21	sinusitis	Teeth extractions	3 wk	-		
[35]M29nonetrauma5 yr after surgeryStaph aureusLevofloxacin, duration NRRefused surgery, recurred after 2 months recurred after 2 months[36]M27nonePoor dentitonunknownunknownBroad spectrum abx for 6 weeksResolved without surgical intervention[37]M61nonePrior hx of Pott's puffy tumor 5 mo prior5 dayUnknownUnknownUnknown[38]M63Chronic rhinosinusitisNo known cause2 wkStrep milleri Pasteurella multocidaCo-amoxilav, unknown duration four weeks followed by PO penicillin of 5 moUnknown[4]M79HTN, prostate cancer, CKDNo known causeunknownActinomyces, Fusobacterium, PropinibacteriumAntibiotics for 6 months; po course with amoxililin-clavulanateunknown[5]M52noneTrauma1 moActinomyces, Fusobacterium, Propinibacterium4 weeks IV antibiotic vancomycin, efazidime, metronidazole; then 4Resolved at 6 mo follow up								····	follow u[p
[36]M27nonePoor dentitionunknownunknownunknownBroad spectrum abx for 6 weeksrecurred after 2 months Resolved without surgical intervention[37]M61nonePrior hx of Pott's puffy tumor 5 mo prior5 dayUnknownUnknownUnknownUnknown[38]M63Chronic rhinosinusitis No known cause2 wkStrep milleri 3 wkCo-amoxiclav, unknown duration IV cefotaxime and PO clindamycin for four weeks followed by PO penicillin for 5 moUnknownUnknown[4]M79HTN, prostate cancer, CKDNo known causeunknownActinomycesActinomyces, Fusobacterium, Propionibacterium4 weeks IV antibiotic vancomycin, ceftazidime, metronidazole; then 4Resolved after 2 months							intermedius	unknown duration	
[36]M27nonePoor dentitionunknownunknownBroad spectrum abx for 6 weeksResolved without surgical intervention Unknown[37]M61nonePrior hx of Pott's puffy tumor 5 mo prior5 dayUnknownUnknownUnknown[38]M63Chronic rhinosinusitis No known causeNo known cause2 wkStrep milleri Pasteurella multocidaCo-amoxiclav, unknown duration IV cefotaxime and PO clindamycin for four weeks followed by PO penicillin for four weeks followed by PO penicillin for unknownUnknown[4]M79HTN, prostate cancer, CKDNo known causeunknownActinomyces, Fusobacterium, Propionibacterium4 weeks IV antibiotic vancomycin, cefazidime, metronidazole; then 4Resolved at 6 mo follow up	[35]	М	29	none	trauma	5 yr after surgery	Staph aureus	Levofloxacin, duration NR	0.01
[37]M61nonePrior hx of Pott's puffy tumor 5 mo prior5 dayUnknownUnknownsurgical intervention Unknown[38]M63Chronic rhinosinusitisNo known cause2 wkStrep milleriCo-amoxiclav, unknown duration IV cefotaxime and PO clindamycin for four weeks followed by PO penicillin for 5 moUnknown[2]F58Recurrent sinusitisNo known cause3 wkStrep milleri Pasteurella multocidaCo-amoxiclav, unknown duration IV cefotaxime and PO clindamycin for four weeks followed by PO penicillin for 5 moUnknown[4]M79HTN, prostate cancer, CKDNo known causeunknownActinomycesActinomycesantibiotics for 6 months; po course with amoxicillin-clavulanateunknown[5]M52noneTrauma1 moActinomyces, Fusobacterium, Propionibacterium4 weeks IV antibiotic vancomycin, ceftazidime, metronidazole; then 4Resolved at 6 mo follow up									recurred after 2 months
[37]M61nonePrior hx of Pott's puffy tumor 5 mo prior5 dayUnknownUnknownsurgical intervention Unknown[38]M63Chronic rhinosinusitisNo known cause2 wkStrep milleriCo-amoxiclav, unknown duration IV cefotaxime and PO clindamycin for four weeks followed by PO penicillin for 5 moUnknown[2]F58Recurrent sinusitisNo known cause3 wkStrep milleri Pasteurella multocidaCo-amoxiclav, unknown duration IV cefotaxime and PO clindamycin for four weeks followed by PO penicillin for 5 moUnknown[4]M79HTN, prostate cancer, CKDNo known causeunknownActinomycesActinomycesantibiotics for 6 months; po course with amoxicillin-clavulanateunknown[5]M52noneTrauma1 moActinomyces, Fusobacterium, Propionibacterium4 weeks IV antibiotic vancomycin, ceftazidime, metronidazole; then 4Resolved at 6 mo follow up	[36]	Μ	27	none	Poor dentition	unknown	unknown	Broad spectrum abx for 6 weeks	Resolved without
[37]       M       61       none       Prior hx of Pott's puffy tumor 5 mo prior       5 day       Unknown       Unknown       Unknown         [38]       M       63       Chronic rhinosinusitis       No known cause       2 wk       Strep milleri       Co-amoxiclav, unknown duration       Unknown         [2]       F       58       Recurrent sinusitis       No known cause       3 wk       Pasteurella multocida       IV cefotaxime and PO clindamycin for four weeks followed by PO penicillin for four weeks followed by PO penicillin for the prior       Required further debridement 5 months is to more the prior         [4]       M       79       HTN, prostate cancer, CKD       No known cause       unknown       Actinomyces       Antibiotics for 6 months; po course with amoxicillin-clavulanate       unknown         [5]       M       52       none       Trauma       1 mo       Actinomyces, Fusobacterium, Propionibacterium       4 weeks IV antibiotic vancomycin, ceftazidime, metronidazole; then 4       Resolved at 6 mo follow up									surgical intervention
[38]       M       63       Chronic rhinosinusitis       No known cause       2 wk       Strep milleri       Co-amoxiclav, unknown duration       Unknown         [2]       F       58       Recurrent sinusitis       No known cause       3 wk       Pasteurella multocida       IV cefotaxime and PO clindamycin for four weeks followed by PO penicillin for debridement 5 months later         [4]       M       79       HTN, prostate cancer, CKD       No known cause       unknown       Actinomyces       Antibiotics for 6 months; po course with amoxicillin-clavulanate         [5]       M       52       none       Trauma       1 mo       Actinomyces, Fusobacterium, Propionibacterium       4 weeks IV antibiotic vancomycin, ceftazidime, metronidazole; then 4       Resolved at 6 mo follow up	[37]	М	61	none	Prior hx of Pott's puffv	5 day	Unknown	Unknown	
[38]       M       63       Chronic rhinosinusitis       No known cause       2 wk       Strep milleri       Co-amoxiclav, unknown duration       Unknown         [2]       F       58       Recurrent sinusitis       No known cause       3 wk       Pasteurella multocida       IV cefotaxime and PO clindamycin for four weeks followed by PO penicillin for four weeks followed by PO									
[2]       F       58       Recurrent sinusitis       No known cause       3 wk       Pasteurella multocida       IV cefotaxime and PO clindamycin for four weeks followed by PO penicillin for debridement 5 months later         [4]       M       79       HTN, prostate cancer, CKD       No known cause       unknown       Actinomyces       Antibiotics for 6 months; po course with amoxicillin-clavulanate       unknown         [5]       M       52       none       Trauma       1 mo       Actinomyces, Fusobacterium, Propionibacterium       4 weeks IV antibiotic vancomycin, ceftazidime, metronidazole; then 4       Resolved at 6 mo follow up	[38]	М	63	Chronic rhinosinusitis	•	2 wk	Strep milleri	Co-amoxiclay, unknown duration	Unknown
[4] M       79       HTN, prostate cancer, CKD       No known cause       unknown       Actinomyces       Antibiotics for 6 months; po course with amoxicillin-clavulanate       unknown         [5] M       52       none       Trauma       1 mo       Actinomyces, Fusobacterium, Propionibacterium       4 weeks IV antibiotic vancomycin, teth aug       Resolved at 6 mo follow up									
[4]     M     79     HTN, prostate cancer, CKD     No known cause     unknown     Actinomyces     Antibiotics for 6 months; po course with amoxicillin-clavulanate     unknown       [5]     M     52     none     Trauma     1 mo     Actinomyces, Fusobacterium, Propionibacterium     4 weeks IV antibiotic vancomycin, etforaidime, metronidazole; then 4 up     Resolved at 6 mo follow	1-1				to more cuuse	5	- istearena mattoria		
[4]       M       79       HTN, prostate cancer, CKD       No known cause       unknown       Actinomyces       Antibiotics for 6 months; po course       unknown         [5]       M       52       none       Trauma       1 mo       Actinomyces, Fusobacterium, Propionibacterium       4 weeks IV antibiotic vancomycin, ceftazidime, metronidazole; then 4       Resolved at 6 mo follow								<b>v</b> 1	
[5] M 52 none Trauma 1 mo Actinomyces, Fusobacterium, 4 weeks IV antibiotic vancomycin, Resolved at 6 mo follow Propionibacterium ceftazidime, metronidazole; then 4 up	[4]	М	70	UTN prostate capcor CVD	No known cauco	unknown	Actinomucos		
[5]M52noneTrauma1 moActinomyces, Fusobacterium, Propionibacterium4 weeks IV antibiotic vancomycin, ceftazidime, metronidazole; then 4Resolved at 6 mo follow	[4]	IVI	79	min, prostate cancer, CKD	IND KHOWH CAUSE	UIIKIIOWII	Actinomyces		UIIKIIOWII
Propionibacterium ceftazidime, metronidazole; then 4 up	( - 1		50						
	[5]	M	52	none	Irauma	I mo	<b>3</b>	<b>5</b>	
weeks oral amoxicillin							Propionibacterium		up
								weeks oral amoxicillin	

NR: not reported.

ω

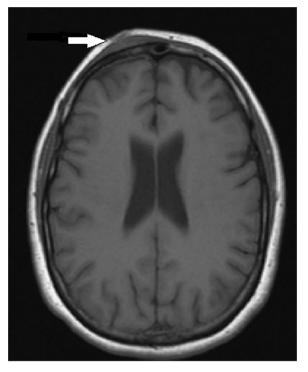


Fig. 1. MRI head revealing right frontal subgaleal abscess along with involvement of the right frontal bone.

surgical interventions), dental issues, and cocaine abuse appeared to be present in majority of the patients. It is felt that the presence of cocaine or tobacco use results in disruption of the mucosal barrier of the nasal passage ways, predisposing to infection [1]. In our patient, we suspect that the preceding dental procedure was the inciting event leading to the development of PPT.

Symptom onset ranged from weeks to years, depending on the risk factors and type of organism implicated. Microbes like *Actinomyces* and anaerobes are more indolent compared to others like *Staphylococcus aureus* or agents of mucormycosis which tend to be more aggressive and onset of clinical symptoms tends to be relatively faster. Of these 47 cases reviewed, *Actinomyces* was reported in two previous cases [4,5].

Treatment most often involves surgical debridement followed by antimicrobial therapy for 4–8 weeks targeted towards the isolated pathogens [1]. In the cases with unknown bacterial involvement, antimicrobials were targeted towards  $\alpha$ -hemolytic streptococci and anaerobes. The majority of cases had good outcomes, with near complete resolution of symptoms. Our patient was treated for 9 weeks with IV ceftriaxone, followed by 6 months of PO doxycycline due to the presence of *Actinomyces naeslundi* which generally requires a longer course of treatment.

Pott's puffy tumor should be considered as a potential diagnosis in people who present with a forehead swelling, particularly in the presence of known risk factors such as sinusitis, head trauma, dental procedures, and cocaine abuse. While staphylococci and streptococci have been commonly implicated, rarely *Actinomyces* may be encountered, especially in indolent cases.

## Credit author statement

All the authors have contributed to the writing of the manuscript of the case report.

#### Sources of funding

No funding applicable to this article

## Consent

Not applicable. We have ensured to not report any potential identifying information in the manuscript.

## **Declaration of Competing Interest**

The authors report no declarations of interest.

#### References

- Akiyama K, Karaki M, Mori N. Evaluation of adult Pott's puffy tumor: our five cases and 27 literature cases. Laryngoscope 2012;122:2382–8.
- [2] Skomro R, McClean KL. Frontal osteomyelitis (Pott's puffy tumour) associated with Pasteurella multocida- A case report and review of the literature. Can J Infect Dis 1998;9:115–1121.
- [3] Goldberg AN, Oroszlan G, Anderson TD. Complications of frontal sinusitis and their management. Otolaryngol Clin North Am 2001;34:211–25.
- [4] Terre Falcon R, Gil-Paraiso P, Ayerbe-Torrero V, Bernat-Gili A, Sanchez-Rubio P. Frontal sinus osteomyelitis by actinomycosis: pott's puffy tumor. Alternative endoscopic treatment. O.R.L. Aragon 2013;16:24–5.
- [5] Pellejero JC, Muñoz AL, Elenwoke N, Franco SC. Pott's puffy tumor by Actinomyces after minor head trauma. Neurocirugia (Astur) 2019;304:198– 201.
- [6] Raja V, Low C, Sastry A, Moriarty B. Pott's puffy tumor following an insect bite. J Postgrad Med 2007;53:114–6.
- [7] Minutilli E, Pompucci A, Anile C, et al. Cutaneous fistula is a rare presentation of Pott's puffy tumour. J Plast Reconstr Aesthet Surg 2008;61:1246–8.
- [8] Lamoreau KP, Fanciullo LM. Pott's puffy tumour mimicking preseptal cellulitis. Clin Exp Optom 2008;91:400-2.
- [9] Martinez-Diaz GJ, Hsia R. Pott's puffy tumor after minor head trauma. Am J Emerg Med 2008;26:739.
- [10] Jung J, Lee HC, Park IH, Lee HCM. Endoscopic endonasal treatment of a Pott's puffy tumor. Clin Exp Otorhinolaryngol 2012;5:112–5.
- [11] Perić A, Milojević M, Ivetić D. A Pott's puffy tumor associated with epiduralcutaneous fistula and epidural abscess: case report. Balkan Med 2017;34:284–7.
- [12] Ball SL, Carrie S. Pott's puffy tumour: a forgotten diagnosis. BMJ Case Rep 2015bcr2015211099, doi:http://dx.doi.org/10.1136/bcr-2015-211099.
- [13] Bannon P, McCormack RF. Pott's puffy tumor and epidural abscess arising from pansinusitis. J Emerg Med 2011;41:616–22.
- [14] Ciobanu AM, Roşca T, Vlădescu CT, et al. Frontal epidural empyema (Pott's puffy tumor) associated with Mycoplasma and depression. Rom J Morphol Embryol 2014;55:1203–7.
- [15] Tatsumi S, Ri M, Higashi N, Wakayama N, Matsune S, Tosa M. Pott's puffy tumor in an adult: a case report and review of literature. J Nippon Med Sch 2016;83:211–4.
- [16] Verbon A, Husni RN, Gordon SM, Lavertu P, Keys TF. Pott's puffy tumor due to Haemophilus influenzae: case report and review. Clin Infect Dis 1996:23:1305–7.
- [17] Koch SE, Wintroub BU. Pott's puffy tumor. A clinical marker for osteomyelitis of the skull. Arch Dermatol 1985;121:548–9.
- [18] Chandy B, Todd J, Stucker FJ, Nathan CA. Pott's puffy tumor and epidural abscess arising from dental sepsis: a case report. Laryngoscope 2001;111:1732-4.
- [19] Tattersall R, Tattersall R. Pott's puffy tumour. Lancet 2002;359:1060–3.
- [20] Kung SW, Chan DTM, Suen PY, Boet R, Poon WS. Pott's puffy tumour. Hong Kong Med | 2002;8:381–2.
- [21] Canbaz B, Tanriverdi T, Kaya AH, Tüzgen S. Pott's puffy tumour: a rare clinical entity. Lancet Infect Dis 2003;3:721.
- [22] Goldfarb A, Hocwald E, Gross M, Eliashar R. Frontal sinus cutaneous fistula: a complication of Pott's puffy tumor. Otolaryngol Head Neck Surg 2004:130:490-1.
- [23] Evliyaoglu C, Bademci G, Yucel E, Keskil S. Pott's puffy tumor of the vertex years after trauma in a diabetic patient: case report. Neurocirugia (Astur) 2005:16:54–7.
- [24] Panda NK, Reddy CEE. Primary frontal sinus aspergillosis: an uncommon occurrence. Mycoses 2005;48:235–7.
- [25] Effat KG, Karam M, El-Kabani A. Pott's puffy tumour caused by mucormycosis. J Laryngol Otol 2005;119:643–5.
- [26] Collet S, Grulois V, Ph Eloy, Ph Rombaux, Bertrand B. Pott's puffy tumour as a late complication of a frontal sinus reconstruction: a case report and literature review. Rhinology 2009;47:470–5.
- [27] Domville-Lewis C, Friedland PL, Santa Maria PL. Pott's puffy tumour and intracranial complications of frontal sinusitis in pregnancy. J Laryngol Otol 2013;127:S35–8.

- [28] Clarós P, Ahmed H, Clarós A. Post-traumatic Pott's puffy tumour: a case report. Eur Ann Otorhinolaryngol Head Neck Dis 2016;133:119–21.
  [29] Miller B. A 60-year-old man with forehead swelling. Cleve Clin J Med
- 2016;83:95.
- [30] Ketenci I, Unlu Y, Tucer B, Vural A. The Pott's puffy tumor: a dangerous sign for intracranial complications. Eur Arch Otorhinolaryngol 2011;268:1755–63.
- [31] Masterson L, Leong P. Pott's puffy tumour: a forgotten complication of frontal sinus disease. Oral Maxillofac Surg 2009;13:115–7.
  [32] Shin JW, Ik GC, Jung S, Kwon H, Shon WI, Moon SH. Pott's puffy tumor appearing with a frontocutaneous fistula. J Craniofac Surg 2012;23:e158–60.
- [33] Tacon LJ, Parkinson JF, Hudson BJ, Brewer JM, Little NS, Clifton-Bligh RJ. Headache of a diagnosis: frontotemporal pain and inflammation associated with osteolysis. Med J Aust 2008;189:591-2.
- [34] Elyassi AR, Prenzel R, Closmann JJ. Pott's puffy tumor after maxillary tooth extraction. J Oral Maxillofac Surg 2012;70:e190–2.
- [35] Upadhyay S. Recurrent Pott's puffy tumor, a rare clinical entity. Neurol India 2010;58:815-7.
- [36] Rehman A, Noor M, Moallam F. Pott's puffy tumor: a rare complication of sinusitis. Ann Saudi Med 2013;33:79–80.
  [37] Rajwani KM, Desai K, Lew-Gor S. Forehead swelling and frontal headache: 0011010007077
- [37] Kajwani KW, Desai K, Lew-Gol S. Folencad sweining and Holital neuractice. pott's puffy tumour. BMJ Case Rep 2014bcr2013202737.
  [38] Williams S, Wilkie M. Pott's puffy tumour: an unforgettable complication of frontal sinusitis. BMJ Case Rep 2014bcr2014204061.