CASE REPORT

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A Pott's puffy tumour as a late complication of a frontal sinus reconstruction: case report and literature review

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SUMMARY

A Pott's Puffy Tumour (PPT) is a rare clinical entity, which, traditionally has been described as an acute abscess with periosteitis secondary to osteomyelitis of the external table of the frontal bone of the skull, complicating an acute frontal sinusitis.

The aim of this article is to present a case of progressively evolving PPT, which emerged during the course of a common rhinitis, in a patient who, thirty years previously, had undergone a reconstruction of the frontal sinus involving osteosynthesis. The patient was treated with antibiotics therapy coupled with external access surgery using the Cairn Unterberger approach. This allowed the drainage of pus, the removal of infected osteosynthetic material and a complete debridement of osteomyelitic bone from the affected area. Frontal sinus obliteration was undertaken using methyl methacrylate, preferable in this case to hydroxyapatite, due to the direct communication with the neighbouring sinus cavities and the presence of defective bone in the superior orbit.

A review of literature available on Medline up to January 2008 reveals that this is the third published case of PPT complicating a frontal reconstruction.

Key words: Pott's puffy tumour/tumor, frontal sinus reconstruction, frontal sinus obliteration, methyl methacrylate

INTRODUCTION

Pott's Puffy Tumour (PPT), initially described by Sir Percival Pott, surgeon at St Bartholomew's Hospital, London, in 1760, corresponds to a clinical diagnosis of a sub periosteal abscess resulting from osteomyelitis of the anterior table of the frontal bone secondary to a frontal sinusitis [(1)] or less commonly secondary to minor trauma at the height of the frontal vault [(2)]. Such tumours mainly affect adolescents. This can be explained by the fact that pneumatisation of the frontal sinus begins only around the age of 7 or 8, and completes itself at adolescence [(3)]; by the greater density of diploic veins in the cranium of children than in those of adults [(4)]; and by a higher degree of traumatic events while attending school.

The classic course is that of an acute infection, and is marked by oedema, erythema and a tumefaction of the frontal area accompanied by fever and headache.

Complications, which arise in more than half of all cases, are neurological in nature and always severe, linked to the infection spreading to the cranial cavity [(5)].

The prevalence of PPT is rare: Younis [(4)] records 2 cases of PPT out of 82 admissions for sinusitis complications over a period of 14 years, and Adame [(6)] notes 4 cases of PPT in 4 years of paediatric admissions, during which time a total of 142 children presented with uncomplicated sinusitis.

The authors report an atypical case of PPT, emerging progressively in the course of a common rhinitis, in a patient having undergone frontal reconstruction 30 years prior following trauma to the forehead.

This case is discussed on the basis of a review of the literature made with the help of Medline from 1966 to January 2008.

CASE REPORT

In March 2006, a patient aged 54 consulted the ENT department of the University Clinic UCL at Mont-Godinne for a swelling and painful tension in the right forehead and the right internal canthus. These symptoms developed progressively over a time course of approximately 15 days after a brief episode of common cold without temperature. They were not accompanied or preceded by any sort of trauma.

Five days prior to consultation, and on the basis of a CT scan of the sinuses, which showed a sub-cutaneous build-up of fluid in the right forehead (Figure 1), the prescribing physician decided to drain the swelling, via an incision, followed by a 48 hour stenting of the area using iodoform gauze. Bacteriological

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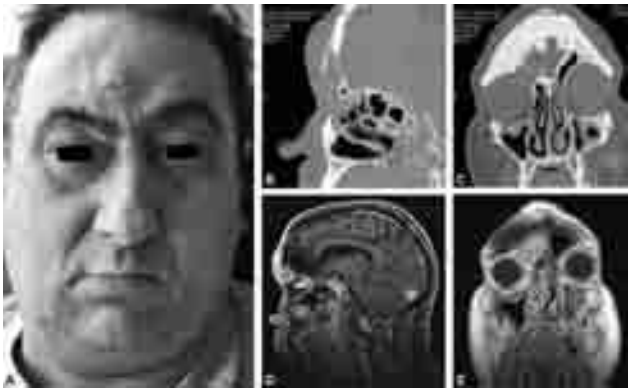

Figure 1. Presentation of the patient. (A) Initial presentation. (B, C) CT scan (sagittal and coronal plane): frontal right sub-cutaneous collection anterior to a synthetic metal plate; osteomyelitis and dehiscence of the frontal anterior bone table at its junction with the frontal bone and the floor of the frontal sinus; suspected old fracture of the posterior table; lesions from bilateral, maxillary and frontal left ethmoidal sinusitis. (D, E) MRI (sagittal and coronal plane): hypersignal T1 frontal right collection with inflamed infiltration of the sub-cutaneous fat in the absence of endocranial lesions.

analysis of the material gathered revealed nothing.
An oral course of amoxycillin-clavulanic acid 500/125 mg, QID was initiated in parallel with the drainage, resulting in progressive improvement of the forehead pain.
The patient had a history of reconstruction of the right forehead following a fracture of the right frontal bone 30 years prior this incident.

Upon admission, a frontal paramedian swelling was noted, slightly distended and painful, extending towards the inner portion of the right orbital rim and the right supra-medial palpebral region (Figure 1). The supra-medial angle of the right orbital frame was interrupted. Endonasal endoscopy was non-contributory. Sight and ocular mobility are intact.
The clinical examination was completed with blood tests, including a white blood cell count, C-reactive protein rate, sedimentation rate, glycaemia and serum immunoglobulins IgA, IgG and IgM count, results of which were normal. An MRI confirmed the collection, which gave a hyper-signal on T1 weighted images as well as the absence of endocranial lesions (Figure 1).
The patient was hospitalised. Due to the clinical and subjective improvement, intravenous treatment with amoxycillin-clavulanic acid, 3 times 2g per day, was continued.
An external surgery using the Cairn Unterberger procedure, which is a bicoronal orbitozygomaticomalar incision that allows an extracerebral access to the frontal sinus, was undertaken under general anaesthesia 8 days later. This enabled drainage of the pus and removal of osteosynthetic material (metallic plaques of micro-screwed cranioplastic material) as well as a complete removal of the frontal anterior table where an infra-centimetric centre of osteomyelitis infection was situated. A 3mm hole in the superior portion of the inter-frontal wall of the sinus was discovered peroperatively. The spread of infection was attributed to this, since a mass of bone material was found to block the frontal recess. The mucus was drained and the bone of the posterior table and frontal recess were burred with a diamond drill. The cavity was filled with methyl methacrylate (slow setting Cranioplastic TM Type 1® from DePuy International Ltd) enabling the closure of the inter-sinusal communication and the defect of the inner-anterior bone wall of the right frontal plane. The anterior frontal plate, which lacked sufficient projection despite the previous reconstruction, was also corrected during the same intervention.
Peroperative bacteriological samples remained negative. Intravenous antibiotherapy was subsequently maintained for 10 days postoperatively followed by an oral course for 15 more days.

Current follow-up is at 24 months. The situation remains clinically and subjectively perfect.
A CT scan, taken 18 months after the intervention confirms the graft is well integrated. Initial observations also show harmonisation of the frontal vault and a resolution of the sinus inflammation.

DISCUSSION

On the basis of Table 1, which gathers the 33 cases of PPT published in the last 10 years, it would seem that in addition to the two classic risk factors, acute frontal sinusitis and frontal trauma, two other factors must be considered: diabetes (6 %) and a history of post traumatic frontal reconstruction (9 %), between 7 and 30 years prior to the emergence of PPT. PPT thus appears as one of the possible late complications of frontal reconstruction. Verbon did not identify these in his review of the 22 cases of PPT published prior to 1996 [(5)].
Examination of Table 1 further shows that, compared to cases published 10 years previously [(5)], we may invoke a diagnosis of PPT on the basis of an insidious evolution of frontal swelling. Frontal swelling evolved over a period of at least 2 weeks in 17,6 % of the patients in our review. Clinical history thus reveals a particular predisposition such as acute and insufficiently treated rhinosinusitis (patient 11), diabetes (patient 7) or frontal reconstruction, as in the case reported here (patient 1).

Diagnosis of PPT requires a high resolution CT scan, in coronal and axial plane, in order to:

- confirm the presence of osteomyelitis of the anterior table of the frontal sinus, which indicates PPT;
- verify the integrity of the posterior table of the frontal sinus, a relative barrier to the propagation of infection into the cranial cavity;
- precisely measure the extent of the damage to the sinus and the potency of the frontonasal recess and thus to decide the ideal strategy for drainage of both the PPT itself and the sinus infection.

Table 1. Clinical characteristics and treatment of Pott's puffy tumours reported in the literature between 1997 and January 2008.

Ref	n	Publication year	Country	No of case	Age (years)	Sex	Forehead swelling duration	Context
	1	2006	Belgium	1	54	M	3 weeks	Rhinitis Post-traumatic frontal sinus reconstruction 30 years previously
18	2	2005	Egypt	1	62	F	2 days	Diabetes Renal failure
19	3	2005	USA	1	9	M	11 days	Acute sinusitis with pre and postseptal cellulites treated by AB IV and Pos
3	4	2005	USA	1	11	F	1 month	Frontal sinusitis 2 months prior treated by analgesics only
20	5	2004	Canada	1	3	M	5 days	Acute sinusitis
9	6	2004	USA	1	42	F	not done	Open reduction and internal fixation for frontoethmoid fractures and frontal obliteration
21	7	2004	Israel	1	58	M	2 months	Diabetes
22	8	2003	Netherlands	1	8	M	1 weeks	Minor head trauma 3 weeks before
23	9	2003	Turkey	1	67	F	not done	Isolated Presenting sign of an epidural empyema
2	10	2002	UK	1	53	F	36 hours	Injury 3 weeks earlier
24	11	2001	UK	1	14	M	1 week	Acute pansinusitis first treated by AB IV and Pos and antrostomies , antral wash-out and reduction of turbinates. Frontal contusion after frontal injury 5 days prior
25	12	2001	Ireland	4	14	F	not done	Frontal sinusitis Associated with saggital sinus thrombosis
	13				15	F	not done	Pansinusistis Associated with subperiosteal abscess
	14				58	M	not done	Frontal and maxillary sinusitis Associated with subdural empyema
	15				12	F	not done	Pansinusitis Associated with subdural and extradural empyema
26	16 -18	2001	Nigeria	3	not précised			
27	19	2001	Spain	1	12	F	6 days	Pansinusitis
28	20	2001	USA	7	11	M	4 days	Sinusitis Associated with Subdural empyema
	21				11	M	2 days	Sinusitis Associated with epidural abscess Subdural empyema
	22				16	M	not done	Pansinusitis Associated with subdural empyema
	23				18	M	7 days	Associated with epidural abscess
	24				15	M	3 days	Associated with epidural abscess
	25				14	M	1 days	Associated with epidural abscess
	26				11	F	3 days	Sinusitis Associated with epidural and brain abscess
11	27 -30	2000	Israel	4	25,5 (12 to 38)	2F 2M	not done	Sinusitis (4/4), external frontal sinus surgery 7 years previously 7 (1/4)
29	31	1999	USA	1	78	F	2 days	Upper respiratory tract infection a week earlier
30	32	1998	USA		48	M	not done	Right pansinusitis Associated with subdural abscess
	33				12	F	not done	Left pansinusitis Associated with epidural abscess

Bacteriology	Antibiotic therapy	Surgery and treatments	Complications	Outcome
no growth	Amoxillin clavulanate IV 18 days and Pos 2 weeks	Frontal sinus occlusion	–	good at 6 months
Mucormycosis	Cefoperaone, gentamicin, metronidazole IV and Amphotericin B infusions in the fistula	Incision under AL and daily debridement from the fistula	–	good at 3 weeks
Strepto. saccharolyticus	Vancomycin, ceftriaxone, metronidazole IV 1 weeks, Pos 8 weeks	Frontal sinus trephination 2 months later : endoscopic	–	good
Group C β s Srepto	Cefotaxime, vancomycyn, metronidazole IV AB Pos 10 days after	Endoscopic decompression of the frontal abscess	–	good
no growth	Cloxacillin, metronidazole, ceftriaxone IV 7 days and 6 weeks Pos	Bicoronal subgaleal approach. Cranialisation	*Frontal epidural abscess at 24h*: via craniotomy	good at 10 days
not done	not done	Endoscopic frontal sinusotomy (Draf II) with stereotactic navigation	–	good at 6 months
not done	Cefuroxime	Local lavage of the wound	*Fistula* Osteoplastic surgery to obliterate sinus and correct the fistula	good
Strepto millieri	Not specified AB IV 1 week, Pos 4 weeks after	Drainage with "glove-drain" 9 days	–	good at 2 weeks
Pseudomonas aeruginosae	not done	–	*Epidural empyema* External approach with fitting of an epidural drain	good at 20 days
Strepto. Milleri	Yes but not named	–	*Subperiostal abscess and subdural empyema* Bifrontal craniotomy	death after 5 days
Strepto. Intermedius Anaerobes	Flucloxacillin, fusidic acid, metronidazole IV 2 weeks Cephalosporin, metronidazole, rifampicin Pos 4 weeks	Incision –drainage and gentamicin beads setting for 2 weeks	–	good at 3 months
no growth	Third-generation cephalosporin and metronidazole	Frontal trephine, antral washout, craniotomy	–	good
Gram + cocci strep species		Frontal trephine, antral washout, craniotomy	–	good
no growth		External fronto-ethmoidectomy, craniotomy	–	good
Haemph. Infl.		Frontal trephine, intanasal ethmoidectomy,antral washout, craniotomy	–	good
no growth	Ceftriaxone, metronidazole, vancomycin IV 6 weeks	Bicoronal skin incision, frontal opening-aspiration and reposition of the craniotomy flap	*Interhemispheric subdural empyema* Frontoparietal craniotomy	good at 3 months
Fusobact. Str. Pneum	not specified AB IV 6 weeks postop.	Craniotomy and drainage	–	good
Str. Millieri			–	
Klebsiella Peptostrepto.			*Reaccumulation of empyema* Drainage via craniotomy	
Microaerophilic Str.			–	
Peptostrept.			–	
Str. viridans			*Subdural and interhemispheric empyema* Drainage via craniotomy	
Str. B hemol. gr A			–	
Staph. Aureus (4/4) Staph. Epidermidis (1/4)	Amoxillin clavulanate IV and Pos 6 weeks	Endoscopic frontal sinusotomy	–	good
not done	not done	not done	not done	not done
no growth	Ceftriaxone, nafcillin, metronidazole	No precise description of sinus and neurosurgical procedures	–	good
no growth			–	good

MRI is indicated:
- in children and adolescents, in order to exclude an intracranial extension, since 58,8 % of diagnosed cases of paediatric PPT present with endocranial infection (Table 1);
- in any patient where the clinical analysis suggests an endocranial complication;
- in any patient where a discontinuity of the posterior table of the frontal bone, resulting from an osteomyelitis and/or a post-traumatic condition, is suspected.

Treatment aims to stabilize the clinical state; treat the osteomyelitis; drain the subperiostal abscess; treat any sinus disease that may be responsible; assure the protection of the intra-cranial area and treat any associated endocranial complications via craniotomy with the help of a neurosurgeon.

Antibiotic therapy is mandatory. Initially it must cover *Staphylococcus aureus*, the most frequently identified bacteria, Streptococci and anaerobes, and then, if possible, be adapted to the results of the bacteriological analysis. On the basis of our review, as well as that of Verbon [5], it would appear that therapeutic strategies are dependent of the type of surgical drainage and endocranial involvement:

a) When undertaking endonasal surgery, cephalosporins are the first choice due to their diffusion capacity within bone. These are administered over a prolonged period, to counter osteomyelitis, initially intravenously for 1 week, in order to ensure sufficient concentration within the bone structure, after which oral administration continues for 6 weeks.
b) When an external route is utilised, with excision of the osteomyelitis area, amoxycillin-clavulanic acid is an alternative, intravenous administration for 1 to 2 weeks, followed by 4 weeks orally.
c) When there are endocranial complications, whichever strategy is decided upon, cephalosporins are the ideal choice, 1 week intravenously, and then 6 weeks orally.

Three options are possible for the draining of a PPT:

a) *An incision and drainage of the swelling* is indicated for an isolated post-traumatic PPT, or as a complement to endonasal drainage, in the case of a PPT secondary to acute rhinosinusitis [7].
b) *An endonasal approach* with a frontal sinusotomy and drainage of the abscess via the frontal recess is indicated if permeability can be guaranteed. These options have been preferred procedures over the last 10 years. They have limited morbidity, absence of subsequent facial scarring and give the possibility of treating the initial sinus [8,9].
   PPTs which occur after a post-traumatic frontal reconstruction are treated in this way, as reported by Deutsch [10] in 2000 (patients 23, 27-30) and Chandra (11) in 2004 (patient 6), assuming that there is no obstacle, such as, in particular, post-traumatic occlusion of the frontonasal recess as suggested by the images.
c) *An external approach* is the standard approach in treatment of PTT, as it enables the drainage of the purulent collection and the removal of the zone of osteitis in the anterior table of the frontal sinus [5,12]. Currently this approach is reserved for those patients who have an obstruction of the frontonasal region which cannot be encompassed endoscopically.
   In cases of previous trauma, two other elements may influence the choice of this procedure: the presence of osteosynthetic material in the plane of the subperiostal collection and the aim, within a single operation, to simultaneously correct a potential anterior frontal plate defect
   Methyl methacrylate is an acrylic implant used in paste form for the purpose of frontal obliteration since 1969 by Olson [13]. For this indication it has been validated in several studies with a complication rate of between 0 and 5 % [13-17]. Although one may currently prefer hydroxyapatite cement, which is biocompatible and osteointegrable, methyl methacrylate is indicated if there is any communication between the cavity to be excluded and the neighbouring sinus, as it represents an impervious barrier to fluids, gases and bacteria [14].

CONCLUSION

PPT is a pathology that is the source of debate, despite its accessibility to medical intervention and antibiotherapy.

The cases published in recent years demonstrate, in contrast to earlier publications, the possibility of a more insidious evolution of the condition, which must include previous frontal reconstruction as a potential risk factor. PPT could thus be considered as a rare and late complication of frontal reconstruction.

The choice of treatment, as well as the antibiotic chosen, will depend on the aetiology, the context and the associated complications. Although endoscopic endonasal techniques are the procedures of choice, being minimally invasive and allowing a concomitant treatment of the underlying rhinosinusitis, certain circumstances will still require an external approach. Such is the case when: - there is a prior history of frontal reconstruction accompanied by a compromised drainage of the frontonasal recess, the presence of osteosynthetic material in the infected area, and when there are bony defects resulting in cosmetic problems.

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