The Pott puffy tumor revisited: neurosurgical implications of this unforgotten entity

Case report and review of the literature

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ALTHOUGH the Pott puffy tumor has been relegated to the topic of historical vignettes, it remains a present, although rare, clinical entity in the antibiotic era.³,¹¹,¹⁶,¹⁷,³⁶

Percivall Pott (1714–1788), a surgeon at St. Bartholomew’s Hospital in London, first described this disorder in Observations on the Nature and Consequences of Wounds and Contusions of the Head, Fractures of the Skull, Concussions of the Brain, published in 1760.¹⁶ He reported that “Inflammation of the dura mater, and the formation of matter between it and the skull, in consequence of contusion, is generally indicated and preceded by one [sign]... a puffy circumscribed, indolent tumor of the scalp and a spontaneous separation of the pericranium, from the skull under such tumor.”³,¹⁶

Currently, the Pott puffy tumor is defined as a subperiosteal abscess of the frontal bone that appears as a localized swelling of the overlying region of the forehead associated with frontal osteomyelitis.¹,¹² There have been 37 pediatric cases reported in the literature over the last 28 years with increasing frequency.¹,³,⁶,⁹,¹²,¹³,¹⁵,¹⁸–²²,²⁴,²⁹–³³,³⁷,³⁹,⁴³,⁴⁵,⁴⁶ A high risk of meningitis, intracranial abscess, and venous sinus thrombosis, and early diagnosis and aggressive medical and surgical treatment are essential for optimal outcome in affected patients.¹¹,¹⁷,²⁴,³³,³⁷,⁴³

We report the case of an 11-year-old boy with a Pott puffy tumor complicated by epidural empyema and review the literature.

Case Report

History and Presentation. This 11-year-old boy was transferred to our neurosurgical department from a local hospital with a 6-week history of frontal headaches, which had initially been diagnosed as migraine by his general practitioner. Two weeks after the onset of the headaches, he was treated for presumed tonsillitis with antibiotic medication. His appetite began to deteriorate, and he lost weight. He then noted a sudden-onset midline forehead swelling, which was accompanied by immediate relief of the headaches. The forehead swelling continued to enlarge, prompting his parents to seek further medical advice. There was no history of head trauma and the patient had remained afebrile. His medical history contained nothing related to his presenting condition.

Abbreviations used in this paper: CT = computed tomography; MR = magnetic resonance.
Examinations. Physical examination revealed the child to be thin but well developed. His temperature was 37.7˚C. A 3 × 4 × 1.5-cm, tender, fluctuant swelling of the forehead was noted just above the nasion. The overlying skin was tense and erythematous without discharge (Fig. 1). No lymphadenopathy was detected. The results of the neurological examination were unremarkable.

Laboratory tests revealed a C-reactive protein level of 168 mg/L (normal level < 5 mg/L), an erythrocyte sedimentation rate of 115 mm/hour (normal range 0–10 mm/hr), a white blood cell count of 12.4 × 10^9 cells/L (normal range 4.5–13 × 10^9 cells/L), a hemoglobin level of 10.1 g/dl (normal range 12–16 g/dl), and a platelet count of 478 × 10^9/L (normal range: 150–400 × 10^9/L).

A CT scan of the head showed perforation of the anterior and posterior tables of the patient’s frontal sinus (Fig. 2, left) and extensive sinusitis involving the ethmoid and left maxillary sinus. An MR image of the head demonstrated an abscess in the frontal subcutaneous tissues, extending through an osseous defect in the frontal sinus that communicated with an extradural abscess over the superior sagittal sinus (Fig. 2 right and Fig. 3A–C). The epidural abscess compressed and displaced the sagittal sinus posteriorly (Fig. 3C and D). Subsequent MR venography confirmed the patency of the sagittal sinus as well as the compressive relationship of the abscess to the sagittal sinus (Fig. 3D).

Surgical and Medical Treatment. Intravenous antibiotic therapy (ceftriaxone and metronidazole) was initiated after blood was collected for cultures. The otolaryngology team performed a left maxillary sinus lavage, and the child underwent a frontal craniotomy, resection of the periosteal “puffy tumor,” curettage of the osteomyelitic bone, cranialization of the frontal air sinus, and evacuation of the extradural abscess. The craniotomy was performed through a standard bicoronal skin flap incision. As the scalp was reflected in the subgaleal plane, pus was noted to drain from the mass of granulation tissue, which was centered over the perforation and formed the Pott puffy tumor (Fig. 4 upper). The tumor was carefully resected and removed for microbiological and histological examination. The bone flap was raised, revealing pus and a significant amount of granulation tissue. The inner plate of the frontal bone flap was eroded by epidural granulation tissue (Fig. 4 lower), which adhered tightly to the underlying dura mater. The undersurface of the frontal bone flap was cleared with a high-speed air drill prior to repositioning.

Pathological Findings. Specimens of pus, granulation tissue, bone, and frontal sinus mucosa were sent for Gram staining and sensitivity testing. The tissue specimens proved to contain Gram-positive cocci. Microbiological cultures of pus, granulation tissue, and frontal sinus mucosa failed to grow any organisms.

Histological examination of the frontal sinus mucosa and the granulation tissue showed florid inflammation and intensely inflamed tissue with new bone formation, respectively.
Postoperative Course.

The child’s postoperative course was uneventful and an excellent cosmetic result was achieved. Six weeks after the operation, follow-up Gd-enhanced MR imaging showed no puffy tumor or epidural abscess. There was a small epidural collection with associated enhancement of the dura mater (Fig. 5).

The patient continues to remain neurologically intact.

Discussion

In 1760, Sir Percivall Pott described a puffy, circumscribed, indolent tumor of the scalp with associated inflammation of the dura mater and formation of matter between it and the skull; this has since been known as the Pott puffy tumor. He recognized the lesion as a complication of head injury. In 1879, Lannelongue demonstrated that the Pott puffy tumor can also result from progression of frontal sinusitis to osteomyelitis with erosion through the frontal bone anteriorly. Currently, the Pott puffy tumor is defined as a subperiosteal abscess of the frontal bone that appears as a localized swelling of the overlying region of the forehead associated with frontal osteomyelitis. Although the vast majority of cases are related to acute or subacute presentations, there is one case report of the late development of the Pott puffy tumor approximately 14 years after head trauma. In such cases it is more likely to have associated risk factors for infection such as diabetes mellitus.

Although the tumor has been reported in patients of varied ages, teenagers are the most frequently affected. The youngest child reported to have this condition was 2.5 years old.

Fig. 3. Preoperative Gd-enhanced MR image revealing subcutaneous forehead swelling and a frontal epidural abscess in axial (A), coronal (B), and sagittal (C) views. A preoperative MR venography image (D) demonstrates compression and displacement of the superior sagittal sinus inferiorly and posteriorly.
years old at diagnosis. Gupta and colleagues have emphasized that the occurrence of such a pathological entity in preadolescent children is very rare. To our knowledge, only three cases have been reported in children younger than 3 years of age in the English-language literature since antibiotic agents have been available.

The reason cases in younger children are so rare is that the pneumatized frontal sinus above the orbital ridges does not appear until the child is approximately 6 years of age, and it does not develop completely until late adolescence. The condition is, however, far more common in children and teenagers than adults. A 1996 case report and review of the literature from the Department of Infectious Diseases at the Cleveland Clinic Foundation in Ohio found that “only seven cases of Pott’s puffy tumor in adults have been reported.”

It is important to consider potential causes in the differential diagnosis in addition to frontal sinusitis. Both the Pott puffy tumor and epidural abscess can occur as a result of dental sepsis. There is a report of a Pott puffy tumor presenting as a complication of maxillary sinusitis. A case of latent mastoiditis presenting with a Pott puffy tumor has also been described. Excessive intranasal cocaine use has been associated with numerous medical problems and a Pott puffy tumor was reported in a patient who chronically abused cocaine. Frontal osteomyelitis, a Pott puffy tumor, and an epidural abscess, have been reported in a wrestler following a blow to the head. The symptoms may be minimal and manifest only in a mild headache and occasional nasal congestion. An unusual case of metastatic bronchogenic carcinoma involved the frontal sinus and masqueraded as a Pott puffy tumor. A pathological fracture and persistent changes in the lung on radiography prompted fine needle aspiration of the mass, which revealed a poorly differentiated adenocarcinoma.

The administration of antibiotic agents alters the natural course of the disease process. If antibiotic medications are used inappropriately or if the dosage or duration of treatment is inadequate, an imminent intracranial complication may be masked. Since the advent of antibiotic agents, pediatric as well as adult cases of the Pott puffy tumor have become rare. Clayman and coauthors reported a 3.7% rate of intracranial complications from paranasal sinusitis in a study of 649 inpatients with acute or chronic sinusitis. The complications included meningitis, subdural empyema, intracerebral abscess, epidural abscess, and rarely, cavernous or sagittal sinus thrombosis.

The frontal sinuses are actually ethmoid air cells that have extended anteriorly and superiorly into the frontal bone. Air cells first appear within the horizontal portion of the frontal bone during infancy, when the child is approximately 6 months old. When the child reaches 2 years of age, pneumatization progresses into the vertical segment of the frontal bone, and at this point the true frontal sinus is defined. The frontal sinuses move to a position above the orbital ridge during the 5th or 6th year of life, and are not completely developed until late adolescence. The anterior wall of the frontal sinus is the thickest of all the sinus walls and forms the contour of the brow and forehead. The posterior wall is composed of hard compact bone that forms the anterior wall of the cranial cavity.

Spread of infection from the paranasal sinuses to the intracranial cavity can occur through the following: 1) retro-
The sinus mucosa, mar-

and low oxygen concentration and reported a 33% rate of long-term morbidity in a reported series of 82 adult and pediatric patients reported a -hemolytic strepto-

Younis and coau-

Erosion and perforation of the poste-

When sinusitis or sinusitis reported in 1978 that no deaths occurred and cerebral abscess in children, the most common causative organisms are the streptococci (at 7251), Haemophilus influenzae, anaerobic bacteria such as Fusobacterium sp. and Bacte-
roides sp., and less frequently, Staphylococcus aureus and Enterococci sp. The low oxygen concentration and low oxidation-reduction potential in inflamed frontal sinus mucosa favors the growth of anaerobic species. Anaerobic infection may be acute but is more often subclinical or chronic. The site of initial infection in the Pott puffy tumor is the frontal sinus. Symptoms experienced by patients with this tumor can include scalp and/or periobital swelling, purulent or nonpurulent rhinorrhea, headache, and fever. Fluctuant and tender erythematous swelling of the scalp at the midforehead is a typical sign. In complicated cases with intracranial abscesses, headache is almost always present. These patients also typically manifest signs of increased intracranial pressure (nausea, vomiting, lethargy) and focal neurological deficits. Frontal osteomyelitis was associated with a high mortality rate in the preantibiotic era. Bordley and Bischofberger reported that the mortality rate for frontal osteomyelitis was 60% at The Johns Hopkins Hospital in Baltimore, Maryland, between 1930 and 1937. During the period when sulfo-namides were used, between 1938 and 1944, the mortality rate was 33%, and from 1952 to 1964, when broad-spectrum antibiotic agents were available and the surgical approach had become more aggressive, the mortality rate dropped to 3.7%. In 1984, Bradley and colleagues reported that subdural and frontal lobe abscess secondary to paras-nasal sinusitis was associated with a mortality rate of 25%. Rosenblum, et al. reported in 1978 that no deaths occurred among 20 consecutive patients with intraparenchymal brain abscesses treated at the University of California, San Francisco, since CT scanning of the brain became a routine diagnostic procedure. In 1989, Remmler and Boles reported a mortality rate of approximately 30% in patients with subdural empyema and noted that approximately 80% of the survivors suffered from motor seizures. Clayman and co-workers reported a 33% rate of long-term morbidity in a series of 24 patients with intracranial complications of para-nasal sinusitis. The most common complications were hemiparesis or hypesthesia, which occurred in four patients (17%) and chronic seizure disorders, which occurred in three (12%); individual cases of decreased cognitive function and residual cranial nerve dysfunction were also reported. In evaluating sinusitis and the possibility of intracranial complications, CT and MR imaging are indispensable and complementary modalities. When sinusitis or sinusitis with complications is suspected or when surgery is being considered, CT is the diagnostic modality of choice, but MR imaging is the gold standard for the diagnosis of any intracranial complication. A subperiostal (pericranial) abscess will be visualized as a hypodense collection of fluid external to the frontal bone with an enhancing rim that represents the thickened, displaced peristomeum; this corresponds to the clinically palpable Pott puffy tumor. Younis and coau-

thors reported a series of 82 adult and pediatric patients with the diagnosis of sinusitis with intracranial or orbital

Fig. 6. Line graph showing the number of cases reported per decade and during the last 5 years (2000–2005).

Prompt medical and neurosurgical intervention is the treatment of choice. 1,3,15,17 Prompt medical and neurosurgical intervention is necessary to prevent deterioration of the patient's condition due to the rapid expansion of the intracranial abscess or venous sinus thrombosis. Preoperative CT and MR images of the head (with and without administration of a contrast agent) help determine the extent of the craniotomy. Treatment should include intravenous administration of broad-spectrum antibiotic agents followed by surgical intervention in the form of evacuation of the subperiosteal abscess, removal of the osteomyelitic bone up to the margins of normal bone, and removal of epidural granulation tissue; care should be taken to maintain the integrity of the underlying dura to avoid intradural spread of infection.1 Infected paranasal sinuses should be evacuated (through aspiration and/or flushing) at the same time. Interestingly, Peloquin and coauthors18 reported a case in which endoscopic sinus surgery alone was used to evacuate an epidural abscess at the base of the right anterior and middle cranial fossa that was secondary to paranasal sinusitis. The decision whether to remove the entire frontal bone flap or remove only the infected part of the bone flap is made on an individual basis. When there are severe osteomyelitic changes in the bone flap—when more than half of its thickness appears moth-eaten or large areas are eroded and perforated—permanent removal should be considered.5 Postoperatively, patients should be treated with antibiotic therapy for 6 to 8 weeks.1,15,17

Upper respiratory tract infections, including sinusitis, are leading causes of visits to the emergency department for children; however, no risk factors for poor outcome have so far been identified in these patients.18

Acute sinusitis often resolves without antibiotic therapy. Chronic sinusitis is often difficult to treat successfully, as symptoms persist even after prolonged courses of antibiotic agents. The treatment of chronic sinusitis is similar to that of acute sinusitis, but the role of bacterial infection, and hence the usefulness of antibiotic therapy, in chronic sinusitis is debated and physicians may therefore be reluctant to treat sinusitis with antibiotic medications. Nevertheless, many physicians believe that some patients with severe asthma have dramatic improvement in their symptoms when their chronic sinusitis is treated with antibiotic therapy.

A review of pediatric case reports suggests that articles on the Pott puffy tumor have increased in the last 5 years (2000–2005; Tables 1 and 2, and Fig. 6). Many factors, such as increased ease of publication and increased readiness to report such cases, may factor into this increase. Also, the previously mentioned reluctance to treat chronic sinusitis with antibiotic agents may result in an increase in the incidence of Pott puffy tumor by contributing to delayed diagnosis and/or preventing effective and complete treatment of frontal sinuses. Consequently, are the potential serious complications of frontal sinusitis underestimated in general practice? The results of our study indicate that there has been an increase in reporting, but further study is required to determine whether there has been a true general or geographically localized increase in the incidence of the Pott puffy tumor and to explore the causes for the increased rate of reporting. In any event, it is clear that this entity has not been eradicated and should not be forgotten. Moreover, it may no longer be as rare as previously thought.

**Conclusions**

Despite suggestions that the Pott puffy tumor is a forgotten entity and predictions of its eradication with the availability of broad-spectrum antibiotic agents, it remains a serious complication of frontal sinuses. In fact, during the past 5 years (2000–2005), the frequency of published reports of pediatric cases has increased. Undiagnosed or partially treated frontal sinusitis may result in this complication, which requires prompt medical and neurosurgical intervention to avoid life-threatening complications including seizures and brain abscesses. Delayed or inadequate treatment

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**TABLE 1**

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**TABLE 2**

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of frontal sinusitis may partly explain the increased rate of reporting. Consequently, early diagnosis and complete treat-ment of frontal sinusitis are required to avoid serious compli-cations such as the Pott puffy tumor.

References

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