



Case Report

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Management of Intracranial Complications of Acute Sinusitis: Our Experience Regarding a Series of Clinical Cases

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Introduction

Sinusitis is a common ear, nose and throat disease which develops from viral or bacterial upper respiratory airway infection. Complications of rhinosinusitis vary from relatively benign to fatal and severe and have been classified into local (5-10%), orbital (60-75%) and intracranial (15-20%) complications [1]. Intracranial complications consist of meningitis, epidural abscess, subdural abscess, intracerebral abscess, cavernous sinus thrombosis and superior sagittal sinus thrombosis. We present a series of 3 cases of intracranial complications of acute paranasal sinusitis treated in our department of oto-rhino-laryngology from January to December 2015 and review the literature.

Case Presentations

The first case: A 44 year-old caucasian man was admitted to the emergency department with acute headache associated with fever, neck stiffness and lowering of the conscious state. Several days before admission he complained about headache without further symptoms. He had no previous medical or surgical history. The clinical examination showed few rhinologic symptoms. The patient was lethargic, but could respond correctly. He was oriented to person and place. White blood cell count was 27,7G/L. Chemistry showed a CRP of 394 mg/L. A computed tomography (CT) showed an extended left-sided pansinusitis with subdural empyema of the left convexity and thrombosis of the superior sagittal sinus (Figure 1).

The patient underwent an immediate left-sided fronto-temporo-parietal craniotomy with evacuation of the empyema, as well as a left-sided maxillary antrostomy and anterior ethmoidectomy by endoscopic approach combined with frontal sinus drainage by external approach (Figure 2). An intra-venous antibiotic treatment was introduced (Piperacillin, 4.5 g 3 times per day). Antithrombotic treatment by Heparin (30000IE per day) was introduced in reason of the thrombosis of the superior sagittal sinus. The bacterial analyses of the subdural empyema showed *Fusobacterium nucleatum*, *Parvimonas micra*, *Prevotella intermedia* and *Enterococcus faecalis*. A lumbar puncture was performed for suspicion of meningitis but

showed no bacterial growth. Post-operative electroencephalogram was abnormal and showed reduced diffuse hemispheric activity with irritative focus in the left-sided centro-temporal areas. Antiepileptic treatment (Levetiracetam, 500 mg 3 times per day) was started.

Post-operative CT-Scan 7 days later showed a progression of the empyema with a mid-line shift of 10 mm. The patient underwent an immediate surgery of the inter-hemispheric abscess. Control cranial CT the following day showed few residual collections. The intravenous antibiotic treatment was continued. No signs of progression or complication were noted.

The patient was hospitalized for 37 days. The antibiotic treatment was then administrated orally for a total of 3 months. The neurological and oto-rhino-laryngological evolution was acceptable with persistent Broca Aphasia. The follow up at one year showed no signs of recurrence of infection, but unfortunately the patient died of pulmonary cancer that was discovered by incidental finding.

The second case: A 37 year-old caucasian man presented to the emergency department with acute headache and severe somnolence since several days. The patient's past medical history was notable for heroine abuse and a thrombosis of the right jugular vein. He was substituted by Methadone and Acenocoumarol. He had a history of severe cranio-facial trauma related to a car accident without sequels. The clinical examination showed a large right-sided frontal mass. The patient was lethargic, but could be aroused with verbal stimulation. He was oriented only to person and place. His neck was supple. White blood cell count was 12,3 G/L. Chemistry showed a CRP of 169 mg/L. A CT-Scan showed a voluminous frontal cerebral abscess of 6x4x5 cm with ring enhancing, associated with a mass effect on the lateral ventricle and mid-line shift of 1.6 cm to the left. There was a peri-lesional edema, a frontal osteitis, a subcutaneous frontal abscess (Pott's puffy Tumor) and a full right-sided maxillary opacity (Figure 3).

The patient underwent immediate osteoplastic frontal craniotomy and gross total excision of a frontal abscess. A surgical draining of the right maxillary sinus was performed by endoscopic approach (Figure 4). An intra-venous antibiotic treatment was introduced (Ceftriaxon, 2 g 2 times per day and Metronidazol, 500 mg 3 times per day). Bacterial culture of the cerebral abscess grew *Staphylococcus haemolyticus*, *Streptococcus constellatus*, mixed anaerobic bacteria and *Prevotella oris*. The antibiotic treatment was not modified regarding the antibiogram.

Repeated cranial CT-Scan 10 days post-operatively showed no residual collections. An electroencephalogram was slightly abnormal and showed little reduced frontal right-sided response. The intravenous antibiotic treatment was followed and the patient was observed in intensive care unit. No signs of progression or complication were noted.

The patient was hospitalized for 46 days. The antibiotic treatment was administrated orally for a total of 3 months.

The neurological and oto-rhino-laryngological evolution was good with persistent encephalomalacia of the frontal lobe on CT and MRI up to one year post-operatively. The patient has no persisting sequels, could go back to work and resume all normal activities.

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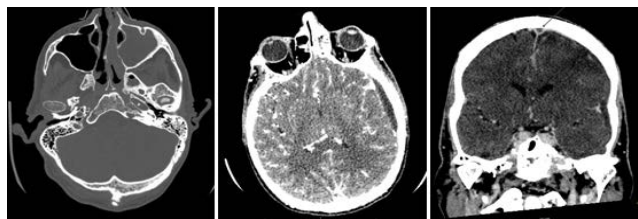


Figure 1: Preoperative axial and coronal CT-Scan (case 1) shows an extended left-sided pansinusitis with subdural empyema of left convexity and thrombosis of the superior sagittal sinus (black arrow).

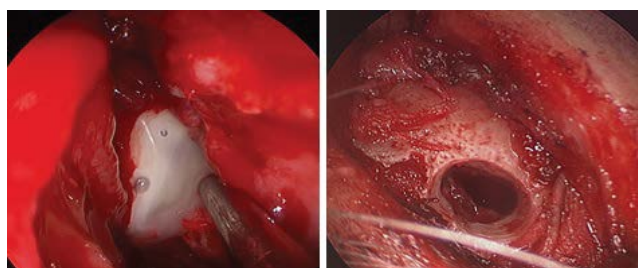


Figure 2: Intraoperative surgical draining (case 1) by endoscopic approach for the maxillary and ethmoid sinuses and external approach for the frontal sinus.

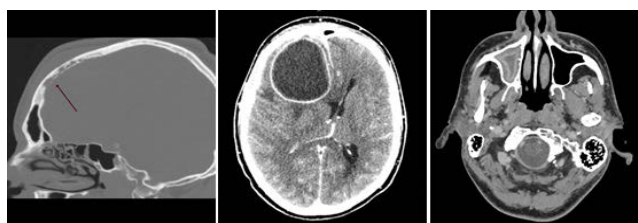


Figure 3: Preoperative sagittal and axial CT-Scan (case 2) shows a frontal osteitis (red arrow), a voluminous frontal cerebral abscess with a mass effect on the lateral ventricle and deviation of the mid-line, as well as a full right-sided maxillary opacity.

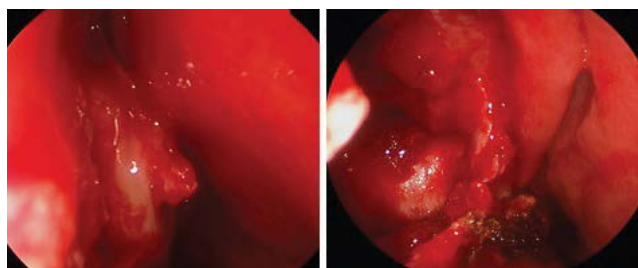


Figure 4: Intraoperative surgical draining (case 2) by endoscopic approach for the right maxillary sinus.

The third case: A 20 year-old caucasian man was admitted to another hospital with acute headache, nasal obstruction and anterior nasal discharge. Few days before he had presented odynodysphagia and was treated by anti-inflammatory medication for a viral angina. There is no previous medical or surgical history. An initial cranial CT-Scan showed an extensive left-sided Pansinusitis without complications. Intravenous antibiotic treatment by a Carbapenem (Ertapenem, 1 g per day) was introduced. Two days later he developed left-sided

retro-orbital pain and more intense headache. A repeated CT-Scan showed a subdural abscess of 13×5 mm in contact with the left frontal bone (Figure 5). He was transferred to our hospital and admitted to intensive care unit. The clinical examination showed few symptoms. The patient was well oriented to person and place. White blood cell count was 10,8G/L. Chemistry showed a CRP of 120 mg/L. The patient underwent an immediate left-sided maxillary antrostomy, anterior ethmoidectomy and frontal sinus drainage by endoscopic approach (Figure 6). No surgical draining for the intracerebral abscess has been performed. The intra-venous antibiotic treatment was changed to a Cephalosporin of third generation (Ceftriaxone, 2 g 2 times per day) and a Nitroimidazol (Metronidazole, 500 mg 3 times per day). A prophylactic anti-coagulative therapy by Enoxaparin was introduced. The bacterial analyses of the pus of the sinuses grew *Fusobacterium necrophorum* and saprophytic Flora. A lumbar puncture was done for suspicion of meningitis but showed no bacterial growth. Post-operative encephalogram was normal.

One week post-operatively the patient presented two epileptic episodes forcing for re-intubation. A repeated CT-Scan showed a slightly growing subdural abscess of 14×6.5 mm. According to the neurosurgeons there was no indication for a craniotomy and evacuation of the abscess. The patient underwent therefore a frontal sinus fenestration by external access for residual collection of the frontal sinus (Figure 6). A drain was left inside and daily rinsed by saline irrigation. An anti-epileptic treatment of Levetiracetam (dose of 500mg 3 times per day) was introduced. There was no further epileptic episode until the end of the treatment 3 months later.

The patient was hospitalized for a total of 23 days. The antibiotic treatment was completed orally for a total of 3 months.

The neurological and oto-rhino-laryngological evolution was normal without persistent sequels. The follow up at one year showed no signs of recurrence of infection.

Discussion

Sinusitis is a common ear, nose and throat disease which develops from viral or bacterial upper respiratory airway infection. Complications of rhinosinusitis vary from relatively benign to fatal and severe. They have been classified into three types: local (5-10%), orbital (60-75%) and intracranial (15-20%) [1]. Local complications are mucocele, osteomyelitis and subperiosteal frontal abscess (Pott's puffy tumor). Orbital complications consist of inflammatory edema, orbital cellulitis, subperiosteal abscess and orbital abscess. Intracranial complications are rare, but may be severe complications of rhinosinusitis. Their incidence ranges from 3,7 to 11% [2] and up to 47% in hospitalized patients with sinusitis [3]. These are meningitis, epidural abscess, subdural abscess, intracerebral abscess, cavernous sinus thrombosis and superior sagittal sinus thrombosis. Main causes of epidural, subdural and intracerebral abscesses are sinusitis of the frontal sinuses [4-6]. Sphenoid and ethmoid sinuses are more predisposed to provoke meningitis and cavernous sinus thrombosis [2,3]. The literature reports about 10% of all intracranial suppuration being caused by sinusitis [3]. Mortality rates ranging from 10 to 70% have been reported in several series, going up to 70% in cases of subdural empyema [7,8].

Meningitis can be acute and rapidly progressive, with fever and headache, as well as with changes in mental status. Epidural abscesses are known to be slowly expanding with less acute pain onset and more local pain and tenderness, whereas subdural abscesses rapidly



Figure 5: Preoperative coronal and axial CT-Scan (case 3) shows an extensive left-sided Pansinusitis and a subdural abscess (circle) in contact with the left frontal bone.

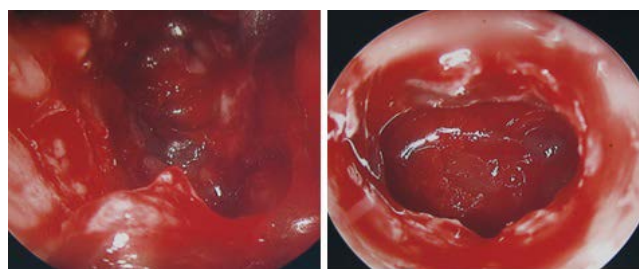


Figure 6: Intraoperative surgical left-sided sinus draining (case 3) by endoscopic approach in a first step and external approach for frontal sinus fenestration in a second step for residual collection.

progress, are often associated to meningitis and rise of intracranial pressure and can lead to focal neurological defects and coma within 24 to 48 hours. Intracerebral abscesses elsewhere have an asymptomatic phase followed by an acute phase of headache, fever and lethargy [2]. Cavernous sinus thrombosis presents often by subacute delay with periorbital swelling, proptosis and ophtalmoplegia [3]. Very specific is retro orbital pain. Patients with superior sagittal sinus thrombosis are extremely ill with high fevers and global neurological defects. It remains a catastrophic complication with a mortality rate of 80% despite aggressive medical treatment [9].

In our series one case showed one intracranial complication (subdural abscess), another case showed one intracranial (intracerebral abscess) and one extracranial complication (Pott's puffy tumor) and the third case showed even 3 intracranial complications (subdural abscess, meningitis and superior sagittal sinus thrombosis). This shows the need of a rapid diagnosis and management of the disease. More than one focus of infection are common [3]. All patients in our series were young male. Two out of three presented without any medical history. One case had experienced a severe cranio- facial trauma many years before. Young men in their second or third decade of life have been reported to have an increased risk of complications of sinusitis [3,9]. In our series they all presented with acute headache. Two of them presented lowering consciousness. Two patients presented to the emergency room already with intracranial complications. One patient developed the subdural abscess under non-sufficient intravenous antibiotic treatment. Two patients needed emergent neurosurgical intervention. One case could be treated by drainage of the sinuses alone.

Frontal sinus has been reported to be the most frequent sinus affected mostly by a pansinusitis who causes intracranial complications in about 3.7% of hospital admissions [4,5]. Bony erosion can lead to subperiosteal abscess or Pott's puffy tumor as well as osteomyelitis that can occur due to the frontal bone's close approximation to the

marrow cavity [9]. Posterior ethmoid and sphenoid sinusitis are strongly associated with meningitis. Sphenoid sinusitis also leads to cavernous sinus thrombosis [4,10,11]. In our series two patients presented with pansinusitis including frontal sinus. Only one patient presented with maxillary sinusitis, which have been reported to be rare and mostly within a dental infection [4].

Sinusitis can spread either by anterograde venous propagation as through the valveless diploic veins of the frontal sinus (veins of Brachet), or through other valveless veins, or it can spread by hematogenic pathway which mostly causes intracranial abscesses [4,12-15]. Moreover it can lead to a direct spread because the continuity between the sinuses and the meninges is no efficient barrier to bacterial spread, and the arachnoids layer cannot prevent the dissemination. The role of chronic rhinosinusitis is still controversial. It has been reported that over many years it can predispose to mucocele that can cause remodeling and thinning of the frontal bone through which an infection can diffuse more easily [9].

The bacterial analyses of the sinuses or intracranial collections can identify the germs in about 53% of the cases [13]. They are often polymicrobial and combine aerobic and anaerobic bacteria. Recent studies have showed up to 60% of *Streptococcus milleri* [5,16]. More common are also other streptococci and enterococci as well as aerobic gram-negative bacilli like *Haemophilus influenzae*, *Escherichia coli*, *Klebsiella*. Less common tend to be *Streptococcus pneumoniae*, *Staphylococcus aureus*, anaerobic gram-positive cocci like *Veillonella* and anaerobic gram-negative bacilli like *Fusobacterium* and *Prevotella* [3]. The bacterial analyses of our series are congruent with these findings. They showed twice *Fusobacteria*, *Staphylococci* and *Prevotella*, mixed with other polymicrobial findings.

As reported before intracranial complications of rhinosinusitis are rare, but can be very severe. Therefore an immediate, aggressive and multidisciplinary treatment needs to take place. Antimicrobial therapy should first be directed to the aforementioned organisms and then be adapted to the antibiogram results. Initial therapy would best be initiated with third generation of cephalosporin, fosfomycine and imidazole [4,13]. The treatment ought to be administered for 3 to 6 weeks with at least 2 weeks of intra-venous medication. Moreover it should always be combined with surgical management by drainage of all affected sinuses that should be done without delay [6]. The surgical treatment of the intracranial complications as intracranial abscess and subdural abscess depends on its size and on the clinical evaluation of the patient. In case of small size without critical aspects of the patient a medical management could be started first under clinical and radiological control [4,17]. In cases of progression surgical draining should be discussed secondarily. Epidural and voluminous intracerebral abscesses require a surgical management from the first intention by craniotomy or burr hole.

Because of a subdural empyema of the left convexity and thrombosis of the superior sagittal sinus as well as the lethargic state, the first case in our series underwent an immediate left-sided fronto-temporo- parietal craniotomy with evacuation of the empyema. In reason of an extended left-sided pansinusitis the operation was completed by a left-sided maxillary antrostomy and anterior ethmoidectomy by endoscopic approach combined with frontal sinus drainage by external approach. As the post-operative CT-Scan 7 days later showed a progression of the empyema with a mid-line shift of 10 mm, the patient underwent an immediate surgery of the inter-hemispheric abscess to prevent further complications.

Our second case presented with a voluminous frontal cerebral abscess of 6×4×5 cm with associated mass effect on the lateral ventricle and deviation of the mid-line of 1.6 cm to the left that needed an immediate osteoplastic frontal craniotomy and gross total excision of a frontal abscess. The operation was completed by a surgical draining of the right maxillary sinus by endoscopic approach in reason of a right-sided maxillary sinusitis to prevent further extension.

In reason of an extensive left-sided Pansinusitis with subdural abscess of 13×5 mm in contact with the left frontal bone our third case underwent an immediate left-sided maxillary antrostomy, anterior ethmoidectomy and frontal sinus drainage. There was no indication for a craniotomy because of the small size of the abscess and the patient's good general condition. Because of two epileptic episodes and a repeat CT showed a slightly growing subdural abscess of 14×6.5 mm with persisting frontal sinusitis the patient underwent therefore a frontal sinus fenestration by external access and a drain was left inside. The size of the abscess was still no indication to the neurosurgeons for a craniotomy and evacuation of the abscess.

Medical therapy by heparin, corticoids and anticonvulsants are still controversial [8].

Any patient with intracranial complications needs to be followed up for a long period of time for a reason of high risk of recurrence and the possibility of neurological and oto-rhino-laryngological sequelae.

Several case reports have been presented in the literature, but only few case series and one large series involving two institutions [3,18]. Although mostly young male are affected like in our case series, Osborn et al presented a case of a 63 year old man presenting with a subdural empyema. The diagnosis was delayed because of the low index of suspicion in an older man and the lack of clinical information given to the radiologist for the interpretation of the CT Scan who suspected a subdural hematoma [3]. This shows the importance of clinical and radiological common workup, especially in untypical cases. Chaayasate et al presented a series of 24 patients with intracranial complications of paranasal sinusitis over a period of 10 years. They found 13 cases of meningitis, 5 brain abscesses and eleven cases of dural venous thrombosis. In their series 7 patients died of the complications, mostly associated with sepsis [1]. Luckily in our series no patient died because of the complications of rhinosinusitis. Holbrook et al presented an unusual case of intracranial abscess of fungal sinusitis in an immune competent patient [19]. We did not find any hyphae in the workup of our patients. It is an uncommon finding, but should be thought of in case of slowly developing symptoms of intracranial complications.

Conclusion

Intracranial complications of acute sinusitis are rare, but can be dangerous and responsible for severe neurological and oto-rhino-laryngological sequelae and can lead to death. The frontal, ethmoid and sphenoid sinuses are most frequently responsible for these complications. The early diagnosis and the multidisciplinary management is fundamental in terms of control of the disease and it will reduce the morbidity and mortality as well as the persisting sequelae. The surgical draining of the affected sinuses is indispensable, whether it is associated or not with neurosurgical drainage, depending on its expansion, and should take place promptly. The antibiotic therapy must be introduced early with large spectrum and need to be adapted according to the antibiogram results. The role of

anticoagulation therapy of sinus thrombosis is still controversial as well as the antiepileptic medication.

Consent

Patients' authorization was obtained for the use of their data and pictures.

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