Case series

How to approach complications of acute rhinosinusitis in children?

Uyttebroek Saartje MD¹; Poelmans Michelle MD¹; Casteels Ingele MD, PhD²; De Vleeschouwer Steven MD, PhD³; Vermeulen François MD, PhD⁴; Jorissen Mark MD, PhD¹; Van Gerven Laura MD, PhD^{1*}

Affiliations:

¹Clinical Department of Otorhinolaryngology, University Hospitals Leuven, Leuven, Belgium

²Clinical Department of Ophthalmology, University Hospitals Leuven, Leuven, Belgium

³Clinical Department of Neurosurgery, University Hospitals Leuven, Leuven, Belgium

⁴Clinical Department of Pediatrics, University Hospitals Leuven, Leuven, Belgium

***Address of correspondence:** Prof. Dr. Laura Van Gerven, Clinical Department of Otorhinolaryngology, Head and Neck Surgery, University Hospitals Leuven, Herestraat 49, 3000 Leuven, Belgium, [laura.vangerven@uzleuven.be], +32 16 33 63 41.

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Abstract

Intraorbital and intracranial complications of acute rhinosinusitis (ARS) are uncommon, but potentially life threatening. Signs of progression of ARS should be recognized early to allow timely surgical treatment in order to avoid irreversible lesions such as vision loss and neurological deficits. In this case series, we provide an overview of 6 representative cases who presented at our tertiary center (2017-2018). The aim of this case series is (1) to draw new attention to the clinical manifestations and management of these complications, since even in highly-developed medical settings we still observe permanent sequelae due to delayed or inadequate treatment, (2) to give an updated analysis of the guidelines, stressing the low threshold for endoscopic sinus surgery, even in children, (3) to underline the benefits of a multidisciplinary approach in these young patients.

Keywords: Acute rhinosinusitis, intraorbital, intracranial, complications, Chandler classification, endoscopic sinus surgery

1. Introduction

Acute infection of the nasal cavity and the paranasal sinuses, also called acute rhinosinusitis (ARS), is very common with an estimated prevalence of 6 to 15%¹ in the general population. Each year it affects about 1% of children^{2,3}. Most cases of ARS occur following a viral respiratory tract infection and are self-limiting^{4,5,6}. In rare cases, acute bacterial rhinosinusitis may progress to severe complications with orbital and intracranial extension.

Orbital involvement accounts for 80% of the complications of ARS^{5,7} and is mostly seen in children under five years old⁸. The maxillary and frontal sinuses of young children are not fully developed, which makes them more vulnerable to ethmoidal involvement⁶. Additionally, the valveless venous network of the thin lamina papyracea in toddlers promotes bacterial spread from the sinuses to the orbit^{5,6,9}. Bacterial extension may provoke inflammation of the periorbital soft tissue and the orbital bone leading to (peri)orbital abscesses, optic neuritis, ischemia of the optic nerve and permanent vision loss^{6,8}. However, the increased pressure as such, associated with abscess formation, can also cause ischemia of the optic nerve by compression of the nutrient vessels, with permanent vision loss as a consequence^{10,11,12}.

Intracranial complications include meningitis, venous sinus thrombosis and subdural, epidural or cerebral abscesses. These complications mostly arise from involvement of the frontal sinus. The frontal bone is provided by a network of valveless diploic veins, which may cause hematogenous spread of the infection. Direct spread of bacteria due to a defect in the cranial base is a less frequent mechanism of extension¹³. These complications are mostly seen in adolescent males as a result of an increased growth rate of the frontal bone in this population, and are associated with substantial mortality (up to 10-20%)¹⁴.

Although complications of ARS are rare in the general population, it may lead to disastrous outcomes. In this case series, we report 6 different, well-documented cases of complicated ARS who presented at our tertiary center (2017-2018).

2. Case reports

2.1. A 15-year-old boy with fever and periorbital pain

A 15-year-old boy was admitted to our hospital due to progressive periorbital pain and swelling of the left eye. One day prior to admission, he consulted the emergency ward with complaints of rhinitis, fever and swelling of the left eyelid without ophthalmological abnormalities. The diagnosis of preseptal cellulitis was made and oral amoxicillin-clavulanate was prescribed. One day later, he was unable to open his eye and he mentioned diminished color perception. On clinical examination, a periorbital cellulitis (figure 1a) and decreased mobility of his left eye was noted. A computed tomography (CT) scan revealed the presence of a subperiosteal abscess. Urgent endoscopic sinus surgery (ESS) was carried out with drainage of the abscess by removal of the uncinate process, opening of the bulla, creation of a large antrostomy and partial removal of the lamina papyracea. Postoperatively, antibiotics were continued and corticosteroids were prescribed. After surgery, the swelling resolved (figure 1b) and his eye movements and color vision normalized. During the last visit, two weeks after surgery, he mentioned complete resolution of his complaints. Afterwards, he was lost to follow-up.

2.2. A 14-year-old boy with vision loss

A 14-year-old boy was referred to our hospital because of ptosis of the left eye and unilateral loss of vision (figure 2a). He had been suffering from left-sided facial pain for one week, he had no symptoms of upper respiratory tract infection (URTI). Two days prior to referral, he consulted elsewhere with swelling of his left eyelids and drainage of pus. His vision, eye movements and pupil reflexes were normal and the diagnosis of preseptal cellulitis was made. He was treated with intravenous amoxicillin-clavulanate. Two days later, ophthalmological examination showed anisocoric pupils with a relative afferent pupillary defect in his left eye, chemosis and strongly limited eye movements. Fundoscopy of the left eye revealed optic disc swelling (figure 2b), the right eye was normal. Additionally, a CT scan showed periorbital cellulitis with a subperiosteal abscess (figure 2c). He was referred to our center for urgent ESS. Opening of the uncinate process, ethmoid bulla, ethmoid, maxillary, sphenoid and frontal sinuses was carried out, showing hyperplastic mucosa. The abscess was drained through a defect in the lamina papyracea. Intravenous (IV) broad spectrum antibiotics and high doses of corticosteroids were administered. After surgery, the periorbital edema and the eye movements normalized. Eighteen months after his surgery, ophthalmological control showed no recovery of vision in the left eye.

2.3. A 2-year-old girl with pharyngitis and swelling of the right eye

A 2-year-old girl was referred to our hospital with swelling of the right eye, not responding to antibiotics. Six days prior to referral, she was diagnosed with a throat infection caused by *S. pyogenes* and oral amoxicillin was started. Three days later, she developed swelling around the right eye (figure 3a) and a CT scan revealed a subperiosteal abscess (figure 3b). Treatment with IV ceftriaxone was started. However, fever, swelling and CT scan did not improve after two days. Therefore, she was referred to our center. She presented with a dry cough, purulent rhinorrhea and high fever. On clinical examination, periorbital erythema and edema were visible and the right eye appeared to be less responsive to light. Assessment of the visual acuity

was difficult, because of the young age. Urgent ESS was carried out with removal of the uncinate process, opening of the maxillary sinus and drainage of the subperiosteal abscess by partial removal of the lamina papyracea. Peroperatively, drainage of pus was visible after removal of the lamina papyracea. Postoperatively, a single dose of corticosteroids was administered, intravenous ceftriaxone was continued for three days and was then switched to oral amoxicillin-clavulanate with complete resolution of the symptoms. During the last visit, one month postoperatively, she was asymptomatic and the vision was normal.

2.4.: A 16-year-old boy with a generalized seizure

A 16-year-old boy presented to the emergency department with periorbital pain, fever and severe headache since three days without URTI-signs. There were no limited eye movements or vision loss. At the emergency ward, he had a generalized tonic-clonic seizure. Neurological examination revealed left hemiparesis and mild central paresis of the facial nerve. A CT scan only showed signs of ARS, but magnetic resonance imaging (MRI, figure 4) revealed an interhemispheric empyema. The patient was referred to our center for craniotomy and drainage of the empyema. After the craniotomy, ESS was conducted with opening of the ethmoid, maxillary and frontal sinuses. Drainage of pus was visible after removal of the uncinate process and opening of the ethmoid bulla. Broad spectrum intravenous antibiotics and anti-epileptic agents were administered. Four months postoperatively, he mentioned complete recovery. Unfortunately, he developed generalized seizures two months later and anti-epileptic agents were continued up until now.

2.5. A 15-year-old boy with headache and somnolence

A 15-year-old-boy presented with frontal pain, fever, nausea and vomiting. He had been suffering from frontal headaches for four weeks and was treated with amoxicillin-clavulanic acid since five days. There were no signs of URTI. On the day of admission, he appeared somnolent and delayed. Muscle strength and sensory function were normal and there were no signs of meningeal irritation. A CT scan showed a prominent cystic mass with surrounding edema in the right frontal lobe, arising from a frontal sinusitis (figure 5). Stereotactic aspiration of the mass was performed followed by ESS with opening of the frontal, maxillary and anterior ethmoid sinuses. Peroperatively, drainage of pus was visible after opening of the right frontal sinus. There was no bony defect visible within the frontal sinus. Broad spectrum antibiotics including ceftriaxone, vancomycin and ornidazole were administered. Shortly after his hospitalization, his parents reported ongoing behavioral changes and memory loss. Luckily, 5 months after his surgery his complaints resolved.

2.6. A 15-year-old boy with paresis of the left leg

A 15-year-old boy presented with severe frontal headache without rhinological complaints since three days. He also mentioned hypoesthesia and weakness of his left leg. On clinical examination, he was alert and afebrile. His pupillary reflexes, eye movements and cranial nerves were normal. Terminal neck stiffness was present, but Kernig sign was negative. Passive and active mobility of his four limbs were normal. A CT scan showed ARS in all paranasal

sinuses, without cerebral anomalies. A lumbar puncture demonstrated 361 white blood cells (WBC) per μl and decreased glucose levels. Limited ESS was performed for bacteriological sampling. During hospitalization, he developed persistent paresis of his left lower leg. For this reason, an urgent MRI (figure 6) was carried out revealing a small epidural abscess in the right frontal lobe, a subdural empyema and thrombophlebitis of two cortical veins. An urgent drainage of the empyema was carried out followed by bilateral, extensive ESS. During the surgery, drainage of pus was visible after opening of the ethmoid bulla and the frontal sinus. Broad spectrum antibiotics and prophylactic anti-epileptic drugs were administered. Postoperatively, the paresis in his left leg recovered gradually over the course of days. At the last visit, two months after surgery, he mentioned complete recovery of his complaints.

3. Discussion

Complications of acute bacterial rhinosinusitis are divided in two categories: intraorbital and intracranial complications. The peak incidence of these complications is seen in children in the first decade of life^{6,8,7,15} and adolescent males^{13,14,7-16} respectively, as illustrated in this case series. Children may present with orbital complications without initial rhinological complaints. For this reason, signs of orbital involvement should be carefully assessed in this age group. Red flags include proptosis, chemosis, ophthalmoplegia, diminished (color) vision and pain with eye movements. Children with intracranial complications may present with non-specific symptoms including somnolence, high fever, headache, nausea and vomiting^{1,17}. Neurological examination and a CT scan are essential. In selected cases, an additional MRI scan may be necessary to evaluate intracranial complications and distinguish subdural from epidural empyemas^{2,15,16}.

In 1970, *Chandler et al.*¹⁸ proposed a classification system for staging of orbital complications of ARS. The Chandler classification divides orbital complications in five groups, including preseptal cellulitis, orbital cellulitis, subperiosteal abscess, orbital abscess and venous sinus thrombosis. Although it is widely used, the Chandler classification has some pitfalls. For example, decreased visual acuity is only described in group IV but according to our experience it is also present in group III. Furthermore, venous sinus thrombosis is described as an orbital complication of ARS, but actually it is an intracranial complication.

The management of orbital complications, proposed by *Chandler et al.*¹⁸, consists of oral or intravenous antibiotics in group I and II and surgical treatment in group III to V. All orbital complications without improvement after 48 hours of antibiotic therapy also require urgent surgical drainage¹⁸. According to *Fokkens et al.*¹, indications for drainage include a subperiosteal or intraorbital abscess on CT or MRI scan and the absence of improvement or progression of orbital symptoms or the patient's general condition after 24 to 48 hours. Reduced visual acuity, reduced color vision, affected afferent pupillary reflex or inability to assess vision are also indications for urgent surgical intervention. These findings are consistent with other publications^{5,8,11}. On the contrary, subperiosteal abscesses in young children without systemic involvement, a normal vision and clinical improvement after 24 to 48 hours of antibiotic therapy, can be treated conservatively^{8,9}. In our experience, we recommend a low threshold towards a surgical intervention in case of doubt or clinical progression under antibiotics, since the complications associated with endoscopic sinus surgery are very limited. According to a recent multicenter study the rate of ophthalmological complications after ESS is 0.2%, with unilateral rectus muscle trauma being the most common injury, potentially

resulting in diplopia¹⁹. In contrast, the rate of visual loss in patients with a subperiosteal abscess is between 14-33%¹¹. In high-volume centers, adequately equipped with pediatric instruments and endoscopes and ENT-staff experienced in pediatric endoscopic sinus surgery, this complication rate might be even lower and not comparable with the disastrous consequences of a delayed intervention as demonstrated in case 2.

Intracranial complications of ARS form a different group and are not included in the Chandler classification. In patients with intracranial complications, urgent drainage of the intracranial abscess or empyema should be performed, combined with an endoscopic opening of the paranasal sinuses and the administration of intravenous broad-spectrum antibiotics^{1,14,15}. A recent study demonstrated that the absence of ESS in the initial management of ARS has been associated with repeat craniotomies due to the lack of source control¹⁷. On the other hand, according to *Garin et al.*³, a purely endoscopic treatment using a Draf III approach may be sufficient to treat small epidural abscesses. Subdural empyemas should always be treated more aggressively, including both ESS and drainage through a craniotomy³.

Overall, a close collaboration between the various specialties (ophthalmologists, ENT surgeons, pediatricians and neurosurgeons) is of utmost importance and essential for a good outcome in these patients¹⁷.

4. Conclusion

Complications of ARS are rare but can cause poor outcomes in children, including vision loss and neurological deficits. A multidisciplinary approach between various specialties is therefore of utmost importance. In our experience we recommend a low threshold for surgical drainage at the early stage of complicated ARS, rather than conservative treatment.

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Declaration of competing interest

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Attachments

Figure 1

Figure 1: (a) Swelling and redness of the left eye. (b) Reduction of the swelling, three days after urgent endoscopic sinus surgery

Figure 2

Figure 2: (a) Ptosis and erythema of the left eyelid, (b) *left* Fundoscopy of the right eye with normal aspect of the optic nerve, *right* Fundoscopy of the left eye, revealing papilledema. (c) Axial CT-image of the subperiosteal abscess of the left eye

Figure 3

Figure 3: (a) Anisocoric pupils, periorbital edema and redness of the right eye with absent light reflex, (b) Axial CT-image of the subperiosteal abscess of the right eye

Figure 4

Figure 4: Interhemispheric empyema with extension to the frontal subdural space on the right side

Figure 5

Figure 5: Cystic mass with surrounding edema at the frontal lobe, measuring 4x4cm

Figure 6

Figure 6: Small epidural abscess in the right frontal lobe and subdural empyema