

Orbital Complications of Sinusitis

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SUMMARY

Orbital complications of sinusitis in the sense of Chandler's classification represent an emergency condition, requiring quick diagnosis and aggressive treatment. Rhinoendoscopy, ophthalmological examination and CT of the paranasal sinuses and orbit enable determination of the stage and origin of the complications. In the case of periorbital cellulitis and the early stage of orbital cellulitis, conservative intravenous antibiotic therapy is possible. Monitoring of the inflammation parameters and the ocular finding is mandatory. In the case of lack of improvement or deterioration of the symptoms within 24-48 hours and in more advanced stages of orbital complications, surgical treatment is also essential. The aim of the study was to evaluate orbital complications of inflammation of the paranasal sinuses with regard to epidemiology, clinical symptoms and management. Retrospective data was evaluated from 8 patients who were admitted to the Department of ORL and Head and Neck Surgery of the Louis Pasteur Teaching Hospital in Košice with suspected sinogenic orbital complications from 2008 to 2013. The patients were analysed in terms of gender, age, CT findings, microbiology, clinical symptoms, stage of complication and treatment. Males and females were afflicted within a ratio of 1.66:1. Young adults in their 20s and 30s predominated (62.5%). Acute and chronic sinusitis were the cause of orbital complications in equal proportions. The most common origin of complications was ethmoid sinusitis (62.5%), followed by maxillary (25%) and frontal (12.5%) sinusitis. An image of polysinusitis with affliction of the ethmoid, maxillary and frontal sinuses (75%) predominated on CT of the paranasal sinuses. *Staphylococcus epidermidis* and *Staphylococcus aureus* were determined as the etiological agents in half the cases. The ocular symptoms recorded were: periorbital edema (100%) protrusion of the eyeball, restriction of movement, chemosis of the conjunctiva (50%), diplopia and secondary glaucoma (12.5%). On the basis of the conducted examinations, preseptal cellulitis – stage I was diagnosed in 3 cases (37.5%), orbital cellulitis – stage II in 3 cases (37.5%) and subperiosteal abscess – stage III in 2 cases (25%). Combined therapy was applied to all the patients (100%) – i.v. antibiotics and surgical treatment within 24 hours. Eradication of the disease from the area of the ostiomeatal complex (OMC), drainage of the afflicted sinuses and drainage of the subperiosteal abscess were performed by the method of functional endonasal endoscopic surgery (FEES). In the case of a superior subperiosteal abscess, a combined endonasal and external approach (external orbitotomy) was required. The average period of hospitalisation was 7 days. Quick diagnosis and aggressive combined therapy of orbital complications of inflammation of sinusitis reduces the danger of prevent loss of vision and life-threatening complications.

Key words: orbital complications, sinusitis, OMC, FEES

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INTRODUCTION

The orbit is defined as a paired bone space, localised on both sides of the nose. Its content comprises the eyeball and associated structures such as the extraocular muscles, optic nerve, a. ophthalmica – branch, a. carotis interna, v. ophthalmica superior and inferior. As a rule the majority of venous blood is drained via the path of the v. ophthalmica superior into the cavernous sinus. The v. ophthalmica inferior most frequently draws off blood retromaxillary into the plexus pte-

rygoideus, and less often into the cavernous sinus. The orbit is lined with the periosteum, which is known as the periorbit. Frontally this passes into the surrounding periosteum, in the rear into the dura mater. The septum of the orbit passes from the edges of the eye socket under the m. orbicularis oculi, and binds to the outer edge of the upper and lower tarsus. Together it forms the anterior closure of the eye socket. The periorbit and orbital septum represent an effective barrier against the spread of infection into the orbit. For this reason, the orbital septum is also significant in the clas-

sification of orbital complications into preseptal and postseptal.

The paranasal sinuses (PNS) are a group of air-filled spaces in the bones surrounding the nasal cavity, together with which they form a functional unit. Superiorly they reach up to the cranial base. The lower part (the bottom) of the frontal cavity forms the ceiling of the eye socket, the ceiling of the maxillary cavity forms the base of the eye socket, the lamina papyracea, forming the medial wall of the orbit, separates it laterally from the ethmoid cavities. The tip of the orbit is next to the sphenoid cavity. The close relationship

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of the paranasal sinuses to the orbit and the cranial base enable a spread of the inflammation into the orbit and intracranium via a pathway of preformed neurovascular foramina, bone dehiscences, inflammation bone erosions or by means of thrombophlebitis of the ethmoid and orbital veins, which do not have valves.

Complications of inflammations of the PNS occur in the above-described manner. Complications of acute or chronic recurring rhinosinusitis are orbital (60-75%), intracranial (15-20%) or bone-related (5-10%) (3). The most common source of orbital complications is the ethmoid sinuses, less often frontal or maxillary. Orbital complications represent an emergency condition due to the possibility of the incidence of life-threatening intracranial complications. Untreated inflammation of the soft tissues of the orbit may lead to loss of sight. The incidence of blindness remains at 10%, in comparison with the pre-antibiotic era, when it was 20% (17). Early identification, correct diagnosis and aggressive therapy are essential in order to limit sinogenic orbital complications.

The staging and classification of orbital complications is very important for the correct therapeutic procedure. In 1937, Hubert was the first to classify orbital complications. In 1970, Chandler (3) divided orbital complications into five groups: group I – preseptal cellulitis, group II – orbital cellulitis, group III – subperiosteal abscess, group IV – orbital abscess and group V – cavernous sinus thrombosis. This classification became widely accepted and was later modified by a number of authors: Moloney (9), Stammberger (15) and Motimore (10).

In the study sample we present our experiences with the diagnosis and treatment of orbital complications at the Department of Otorhinolaryngology and Head and Neck Surgery of the Louis Pasteur Teaching Hospital in Košice over a period of 5 years.

MATERIAL AND METHOD

The study is based on a retrospective analysis of the medical records of patients admitted to the Department of ORL and Head and Neck Surgery at the Louis Pasteur Teaching Hospital in Košice due to suspected orbital complications upon acute or chronic rhinosinusitis in the period from 2008 to 2013. 8 patients were included in the study sample. The diagnosis of

sinogenic orbital complication was determined on the basis of anamnesis, rhinoendoscopic examination, CT PNS and the orbit in the coronary and axial projection and ophthalmological examination. The analysis was conducted with respect to age, sex, degree of orbital complications, ophthalmological examination, CT finding in the area of the PNS and orbit, cause of orbital complication – acute versus chronic rhinosinusitis, origin of orbital complication, etiological agent, therapy, results of therapy and period of hospitalisation. The degree of orbital complications was determined according to Chandler's classification.

RESULTS

Over the course of 5 years, 9 patients were admitted to the Department of ORL and Head and Neck Surgery at the Louis Pasteur Teaching Hospital in Košice, with suspected sinogenic orbital complications. The subject of the analysis was 8 cases. One case was excluded from the study sample because the rhinoendoscopic and CT examination of the PNS did not confirm a sinogenic cause of edema of the upper eyelid. Upon an ophthalmological examination, a diagnosis of blepharoconjunctivitis acuta was determined, and subsequent treatment was implemented at the department of ophthalmology. Of the 8 patients, 5 were men (62.5%) and 3 were women (37.5%). The men were thus afflicted more frequently than women at a ratio of 1.66:1. Of the sample of 8 patients, 1 child was afflicted (12.5%). The age range of the patients was from 11 to 68 years, the age median was 32 years. Preseptal cellulitis / blepharodema – 1st degree orbital complication was recorded in 3 cases (37.5%), Orbital cellulitis – 2nd degree orbital complication in 3 cases (37.5%), and subperiosteal abscess – 3rd degree orbital complication was found in 2 cases (25%). We did not record advanced orbital complications such as orbital abscess and cavernous sinus thrombosis. The right and left sides were afflicted with equal frequency. Of the ocular symptoms, periorbital edema predominated, which was recorded in all patients (100%). Protrusion of the eyeball was present in 4 cases (50%) – in 3 patients with orbital cellulitis and in 1 patient with subperiosteal abscess. Conjunctival chemosis and restriction of movement of the eyeball were recorded in 4 patients with 1st

and 2nd degree orbital complication. Diplopia and secondary glaucoma was recorded in one case, in a patient with a subperiosteal abscess. Visual impairment was not recorded in any single case. Upon CT examination of the PNS, an image of polysinusitis with affliction of the frontal, maxillary and ethmoid sinus was determined in 6 cases (75%), as well as fronto-ethmoidal sinusitis in 1 case (12.5%) and isolated maxillary sinusitis also in 1 case (12.5%). Upon CT examination of the orbit, protrusion of the eyeball was determined in 4 cases (50%). Of these, 1 represented a case of pneumo-orbit, edema of the m. levator palpebrae superioris and m. obliquus superior and subperiosteal abscess in the arch of the orbit. Acute and chronic rhinosinusitis were the cause of orbital complication in equal measure. On the basis of a CT examination of the PNS and the perioperative finding, ethmoid sinusitis was determined as the origin of orbital complication in 5 cases (62.5%), maxillary sinusitis in 2 cases (25%) and frontal sinusitis in 1 case (12.5%). In all patients a swab was taken for a cultivation examination, in which *Staphylococcus epidermidis* was determined in 3 cases, *Staphylococcus aureus* in 1 case and in the other 4 cases the swabs remained sterile. Intravenous antibiotic therapy was applied to all patients, in which protected beta-lactam penicillins or cephalosporins were applied, in two cases in combination with metronidazole. Surgical treatment was indicated for all patients. The reasons for surgical treatment were: high inflammation parameter (leukocytosis and high values of CRP) in the laboratory image, progression of ocular symptoms (accentuation of periorbital edema, chemosis, protrusion of eyeball, restriction of movement, diplopia) and CT finding of subperiosteal abscess or blocked ostiomeatal complex in the area of the PNS. Surgical treatment in stage I orbital complication aimed to unblock the blocked ostiomeatal complex, treat the finding in the area of the PNS and thus prevent the progression of the ocular symptoms. The method of functional endoscopic endonasal surgery (FEES) was used to treat the finding in the area of the paranasal sinuses and the medial subperiosteal abscess of the orbit. In one case, FEES was combined with an external procedure – orbitotomy, for the purpose of evacuating the abscess in the area of the ceiling of the orbit. In the

postoperative period, a progressive regression of the ocular symptoms was recorded in all patients, as well as an adjustment of the laboratory parameters. The period of hospitalisation was within the range of 3 to 12 days, the average period of hospitalisation was 7 days.

DISCUSSION

Rhinosinusitis ranks amongst the most common diseases occurring in the outpatient practice of general practitioners and paediatricians. The majority of cases regulate themselves *ad integrum*, either spontaneously or following symptomatic and in indicated cases also after peroral antibiotic treatment. In certain circumstances, such as a high virulence of the infectious agent, immune deficiency of the patient and anatomical predisposition, complications occur. The close anatomical relationship of the orbit and PNS explains the occurrence of orbital complications.

In our study sample, men were afflicted more frequently than women, in which the ratio (1.66:1) was slightly lower than in other studies (1, 7, 8, 12, 14). To date no answer has been offered to the question of why this is the case. Under consideration is a better immunological response in women (10). Similarly as in other studies (1, 8, 12), the affliction of young adults predominated (62.5% of patients in their 20s and 30s). In the study sample we recorded only one case of orbital complication in childhood, whereas in the literature children are afflicted relatively frequently (16). The majority of paediatric patients with orbital complications within the observed period were probably treated at the Paediatric Teaching Hospital.

Acute and acute exacerbation of chronic sinusitis was the cause of orbital complication to an equal degree. We assume that in the case of acute sinusitis, the cause of the occurrence of complications is inadequate treatment. Acute bacterial sinusitis is treated with antibiotics. The increase in the resistance of strains of bacteria which cause acquired rhinosinitis within the community requires the administration of wide-spectrum antibiotics, which are protected against β -lactamase or resistant thereto, effective on pneumococcus and gram-negative bacteria. Effective treatment should be based on a cultivation examination before and after

treatment. The length of duration of antibiotic treatment within a community of acquired rhinosinusitis should be 10 to 14 days. In addition to antibiotic treatment, symptomatic treatment is also important (mucolytic agents, decongestants, local corticosteroids and antihistamines), which alleviates edema of the mucous membrane and facilitates the drainage of pathological exsudate from the paranasal sinuses into the nose. In the case of chronic rhinosinusitis with/without polyps, anatomical changes with a block in the region of the ostiomeatal complex (OMC) cause an impairment of the ventilation and drainage function of the PNS, with accumulation of the content, facilitating the occurrence of secondary bacterial infection and the incidence of complication.

The most common origin of orbital complication, similarly as in other study samples (16), was ethmoid sinusitis (62.5%). The lamina papyracea separating the orbit from the ethmoid sinuses represents a weak barrier against the spread of inflammation, which may be further facilitated by dehiscences of this thin bone lamella. Isolated maxillary sinusitis is a less frequent (25%) cause of orbital complication. In the clinical picture, edema of the lower eyelid develops first of all, with edema of the upper eyelid developing only later. If the cause of the origin of subperiosteal orbital abscess is maxillary sinusitis, the abscess is situated on the base of the orbit, and causes dislocation of the eyeball in an upwards direction. It is necessary to keep in mind that isolated maxillary sinusitis is frequently of degenerative origin, in which in addition to aerobic bacterial flora, anaerobic flora is also present. Frontal sinusitis is the least common cause of orbital complications (12.5%). The danger of frontal sinusitis lies primarily in the possibility of rapid occurrence of intracranial

complication or bone-related complication in the sense of osteomyelitis of the anterior or posterior wall of the frontal sinus. Upon CT examination of the PNS, polysinusitis with affliction of the ethmoid, maxillary and frontal paranasal sinuses was determined in 75% of patients (fig. 1).

Similarly as in cases of rhinosinusitis, in orbital complications also the most common etiological agents are *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Moraxella catharalis* and *Streptococcus pyogenes* (8, 13). Upon subperiosteal abscess in connection with maxillary sinusitis, the bacterial flora is mixed. In addition to classic triggers, anaerobic or microaerophilic bacteria are also present, such as peptostreptococci, fuscobacterium and microaerophilic streptococci (2, 8). In the cultivation examination we determined *Staphylococcus epidermidis* and *Staphylococcus aureus* as the causal agents. In half of the patients the swabs remained sterile, which could have been caused by incorrect sampling or processing of the material. In addition to anamnesis, rhinoscopic, ophthalmological and CT examination are essential in order to determine the aetiology of orbital complication. Rhinoscopic examination and CT of the PNS, in which the symptoms of inflammation in the region of the nasal cavity and PNS are determined, confirm the sinogenic cause of edema in the region of the eye. An ophthalmological examination is essential for each patient with suspicion of orbital complication. The first examination by an ophthalmologist may determine another cause of periorbital edema. On the other hand, if a rhinogenic origin of periorbital edema is confirmed, it is precisely the character of the ocular symptoms that informs us regarding the seriousness of the orbital complication. Chandler's classification of orbital complications (3) is also established on a background of ocular symptoms, in which orbital complications are divided into five groups: 1. Inflammatory edema (periorbital or preseptal cellulitis) – painless edema of the eyelid. 2. Orbital cellulitis – edema of the eyelid, proptosis of the eyeball, restriction of movement of the eyeball and chemosis of the conjunctiva. 3. Subperiosteal abscess – accumulation of purulence between the periorbit and bone, which usually dislocates the eyeball laterally and downwards, but may also occur upwards. Vision and movement are



Fig. 1 Fronto-ethmoid-maxillary poly-sinusitis in left eye



Fig. 2 Protrusion of eyeball in left eye

initially unimpaired. 4. Orbital abscess – occurs upon the progression of orbital cellulitis or penetration of a subperiosteal abscess. This is manifested in pronounced proptosis of the eyeball, ophthalmoplegia, chemosis of the conjunctiva and damage to loss of sight. 5. Thrombosis sinus cavernosus – fever, headache, photophobia, periorbital edema. Later proptosis of the eyeball unilaterally or bilaterally, chemosis of the conjunctiva, diplopia, paralysis of the extraocular muscles, deterioration to loss of sight, meningismus, affliction of the nerves of the head. Monitoring of ocular symptoms in patients with orbital complication is mandatory, because their progression or regression is decisive to a considerable degree with regard to treatment. The progression of an ocular finding is decisive in indication for surgical treatment. In our study group, of the ocular symptoms periorbital edema predominated (100%). Protrusion of the eyeball (fig. 2), chemosis of the conjunctiva, restriction of movement of the eyeball were present in 50% of patients – all the patients with 2nd and

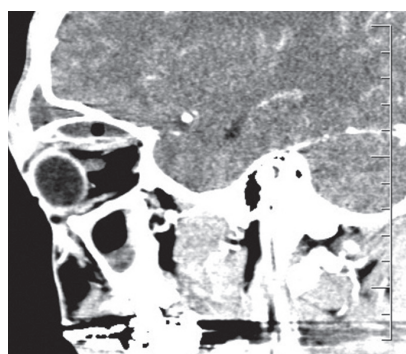


Fig. 4 Subperiosteal abscess in right eye – axial projection



Fig. 3 Subperiosteal abscess in right eye – sagittal projection

3rd degree orbital complication. Diplopia and secondary glaucoma were present only in one patient with a subperiosteal abscess (12.5%).

In addition to the ocular symptoms, CT of the orbit and PNS also has an important role in determining the degree of orbital complication. According to the CT display of the orbit we differentiate three types of complications. I. Orbital cellulitis – diffuse infiltration of orbital fat, characterised by an increase in the density of extra and intraconal fat. II. Subperiosteal abscess – characterised by an elevation of the periosteum by the bone of the orbit adjacent to the paranasal sinuses (fig. 3, 4). III. Orbital abscess – heterogeneous density in the area of orbital fat (5).

In the majority of studies stage I and II of orbital complication predominates, where the frequency within stage I is up to 70%, in stage II up to 44% (12, 14). In our study sample, 37.5% of patients were determined in stage I – preseptal cellulitis, 37.5% of patients in stage II – orbital cellulitis, and 25% of patients in stage III – subperiosteal abscess.

Orbital complications represent an emergency condition and require swift and adequate treatment. A consensus exists that the first stages – preseptal and incipient orbital cellulitis – are treated conservatively by intravenously administered wide-spectrum antibiotics. Medicamentous therapy independently is indicated in the following case: 1. Normal sight, pupil and retina, 2. Unrestricted movement of eyeball, 3. Intraocular pressure less than 20 mmHg, 4. Proptosis of the eyeball less than 5 mm, 6. Medial subperiosteal abscess less than 4 mm (11). If there is no improvement in the clinical condition after 24-48 hours, patients should be operated on (4, 11, 12, 13, 14). Progression of

the finding may occur even despite antibiotic therapy. In our study sample also, we recorded progression of the finding from preseptal cellulitis to subperiosteal abscess in one patient (12.5%) despite treatment. It is precisely the progression of the ocular symptoms in the sense of accentuation of the protrusion, dislocation of the eyeball, diplopia and the incidence of secondary glaucoma that was the reason for surgical treatment. Surgical treatment was indicated by an ophthalmologist. The above documents the importance of monitoring the ocular symptoms and the key role of the ophthalmologist, who often decides on the therapeutic procedure. The indications for surgical treatment are: lack of improvement of local and general condition within 24-48 hours, progression of the finding, non-medial abscess, complication of dentogenic origin, immunocompromised patient, deterioration of sight, manifestations of meningeal irritation. Coenraad (4) asserts that he achieved the best results in his study sample through a combination of medicamentous and surgical treatment. In our study sample, all patients (100%) were treated by this method, regardless of the stage of orbital complication. Intravenous atb therapy was initially commenced on all patients, and within 24 hours of hospitalisation surgical treatment was also implemented on all patients. The reasons for surgical treatment were: high inflammation parameter (leukocytosis and high CRP value) in the laboratory image, progression of ocular symptoms (accentuation of periorbital edema, chemosis, protrusion of eyeball, restriction of movement, diplopia) and the CT finding of a subperiosteal abscess or blocked ostiomeatal complex in the region of the PNS. Surgical treatment in stage I of orbital complication aimed to unblock the blocked ostiomeatal complex, treat the finding in the region of the PNS and thus prevent the progression of the ocular symptoms. Upon surgical treatment it is necessary to open and drain the primary inflammation deposit in the paranasal sinuses and evacuate the abscess from the orbit. In principle two surgical procedures are possible: intranasal by the pathway of functional endoscopic endonasal surgery (FEES) and an external approach (1, 4, 6, 7, 8, 12, 13). At present the majority of complications are addressed using an intranasal approach, which enables the removal of pathological

changes in the region of the OMC, drainage of the PNS and drainage of the subperiosteal abscess (1, 5, 7, 8, 11). It is necessary to resolve non-medial subperiosteal and orbital abscess via an external approach. In our study sample, an intranasal approach using FEES was performed on all patients. An external procedure was also performed in addition to FEES on one patient (12.5%) due to the incidence of a subperiosteal abscess beneath the ceiling of the eye socket – external orbitotomy and evacuation of the abscess with implementation of tubular drainage. Thanks to combined treatment, a regression of local and general symptoms was achieved in all patients, and the period of hospitalisation was shortened to 7 days.

CONCLUSION

Patients with suspected orbital complication must undergo a rhinoscopic examination, ophthalmological

examination and CT of the paranasal sinuses and orbit. On the basis of the above examinations, it is possible to confirm or disprove the sinogenic cause of the changes in the region of the orbit, determine the degree of orbital complication and identify its origin. All patients with orbital complications require urgent treatment. Preseptal cellulitis and incipient orbital cellulitis may be treated independently with intravenous administration of antibiotics. During the course of treatment, monitoring of the inflammation parameters, ocular symptoms and general clinical condition of the patient is essential. In the case of lack of improvement or deterioration of the condition within 24–48 hours, immediate surgical treatment is necessary. We wish to emphasise the irreplaceable role of the ophthalmologist, who may detect the progression of the ocular finding in a timely manner and as a result indicate surgical treatment. In more advanced stages of orbital complications, combined thera-

py is indicated – both conservative and surgical. According to our experience, an aggressive approach to treatment, conservative therapy in combination with surgical treatment during the course of the first 24 hours from hospitalisation upon the stage of preseptal cellulitis onwards, enables a rapid regression of the complaints, correction of the ocular finding, improvement of the general condition of the patient and shortening of the period of hospitalisation. In surgical treatment there is an unequivocal predominance of an intranasal approach via the FEES method, which enables the removal of the inflammation deposit in the region of the PNS and evacuation of the medial subperiosteal abscess of the orbit. An external approach to the orbit is indicated in the case of a non-medial subperiosteal and orbital abscess. Timely and aggressive treatment of orbital complications prevents the loss of sight and the incidence of life-threatening conditions.

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