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Intracranial complications from sinusitis

Wewnątrzczaszkowe powikłania z zakażeń zatok przynosowych

Authors' Contribution:
A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
G – Funds Collection

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ABSTRACT:

Introduction: Despite increasingly better diagnostic and therapeutic methods intracranial sinogenic complications, , invariably pose a direct threat to the lives of patients and a challenge for otolaryngologists.

Aim: The aim of the study was to analyze patients with intracranial sinogenic complications treated at the Department of Otolaryngology and Otolaryngological Oncology of Poznań University of Medical Sciences in the years 2000-2013.

Material and methods: Analysis covered the period from January 2000 to December 2013. Twenty-one patients with intracranial sinogenic complications were treated at the Department of Otolaryngology in Poznan during that time

Results: Material mainly included young men. Brain abscesses were the most common complications. Intracranial complications of sinusitis rarely occurred in isolation, often coexisting with other intracranial pathologies. A significant increase in the incidence was recorded in 2013. Treatment involved concurrently alleviating inflammation in the sinuses through implementation of broad-spectrum antibiotics for several weeks and decompressing the organized intracerebral abscesses, empyema, epidural and/or subdural abscesses under control of neuronavigation. There were no patient deaths recorded in the analyzed period.

Conclusions: The risk of developing intracranial sinogenic complications is low but invariably present and should be included in the differential diagnosis. Since the incidence of intracranial complications may increase in the course of prevailing viral infection, it should raise diagnostic vigilance.

KEYWORDS: sinusitis, intracranial complications, treatment results

STRESZCZENIE:

Wstęp: Zatokopochodne powikłania wewnątrzczaszkowe mimo coraz lepszych metod diagnostycznych i terapeutycznych niezmiennie stanowią stan bezpośredniego zagrożenia życia dla chorych oraz wyzwanie dla otolaryngologów.

Cel pracy: Celem pracy jest analiza chorych z zatokopochodnymi powikłaniami wewnątrzczaszkowymi leczonymi w Klinice Otolaryngologii i Onkologii Laryngologicznej Uniwersytetu Medycznego w Poznaniu w latach 2000-2013.

Materiał i metody: Analizą objęto okres od stycznia 2000 r. do grudnia 2013 r. W tym czasie w Klinice Otolaryngologii w Poznaniu leczono 21 chorych z zatokopochodnymi powikłaniami wewnątrzczaszkowymi.

Wyniki: W materiale dominowali młodzi mężczyźni. Najczęściej stwierdzano ropnie mózgu płata czołowego i ciemieniowego. Zatokopochodne powikłania wewnątrzczaszkowe rzadziej występowały w odosobnionej postaci, częściej współistniały z innymi powikłaniami wewnątrzczaszkowymi. Zanotowano istotny wzrost częstości zachorowań w 2013 r. Leczenie obejmowało jednoczasową likwidację ogniska zapalnego w zatokach przynosowych oraz odbarczenie zorganizowanych ropni śródmózgowych, ropniaków nadtwardówkowych i/lub podtwardówkowych pod kontrolą neuronawigacji, poprzedzone wdrożeniem szerokospektralnej antybiotykoterapii kontynuowanej przez kilka tygodni. W analizowanym okresie nie stwierdzono zgonów.

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Wnioski: Ryzyko rozwoju zatokopochodnych powikłań wewnątrzczaszkowych jest niewielkie, niemniej jednak wciąż istnieje i należy o nim pamiętać w diagnostyce różnicowej. W przebiegu panującej infekcji wirusowej może nastąpić wzrost powikłań wewnątrzczaszkowych, co wymaga wzmożonej czujności w diagnostyce lekarskiej.

SŁOWA KLUCZOWE: zapalenie zatok przynosowych, powikłania wewnątrzczaszkowe, wyniki leczenia

INTRODUCTION

Sinusitis constitutes one of more significant and frequently encountered diseases both in adult and pediatric patients. Various local, orbital and intracranial complications may develop over the course of this disease in the patients. According to the Guidelines prepared by the European Academy of Allergy and Clinical Immunology (EAACI) - EPOS 2012 (European Position Paper on Rhinosinusitis and Nasal Polyps), sinusitis can be classified according to its duration into acute sinusitis – i.e. sinusitis that lasts up to 12 weeks, and chronic sinusitis – i.e. inflammation that lasts more than 12 weeks [10, 11,31].

Although the mucous membrane of the nose and the sinuses is constantly exposed to the influence from the external environment, such as viruses, bacteria, fungi, irritating factors, smoking, allergens, variations in temperature, humidity, as well as changes in internal, i.e. hormonal, neurogenic or immunological factors, sinusogenic intracranial complications are observed less frequently than e.g. otogenic complications [29,33]. Although a significant part of inflammatory lesions within the sinuses result from viral infection, distinguishing primary viral infection from bacterial infection is difficult, as their subjective and objective symptoms are similar. That is why antibiotics are frequently used for the treatment of sinusitis. Rhinoviruses, parainfluenza and influenza viruses are the most frequently isolated viruses, whereas Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis are the most frequently isolated bacteria. Other Streptococcus species and aureus Staphylococci are observed in a small percentage of cases. Anaerobic bacteria, which are closely related to dental infection, are an important etiological factor for acute inflammatory lesions. Fungi species that are considered the cause of sinusitis in immunosuppressive patients are the fungi of Mucoracea and Trichocomaena families. These fungi cause sinusitis with significant damage to osseous tissue and dangerous orbital intracranial complications.

The increase in prevalence of sinusitis is related significantly to the pathology affecting the key ostiomeatal complex, which leads to disorders in ventilation and drainage of paranasal sinus cavities. Attention is paid to chronic sinusitis with polyps in patients with hypersensitivity to non-steroid anti-inflammatory drugs [10, 19].

A review of literature concerning the prevalence of complications of sinusitis since the beginning of the previous century reveals that intracranial sinusogenic complications are observed approximately four times less frequently than they used to be in previous years. Nevertheless, the prevalence of some complications, e.g. orbital complications, has not changed significantly [5]. Morbidity over the course of intracranial sinusogenic complications has been decreasing along with the introduction of new generation antibiotics, the development in diagnostic techniques, improvement in rhinosurgery, and especially the introduction of neuronavigation. The increase in the patients' awareness concerning the need of treatment in case of sinusitis cannot be overlooked. Before the introduction of antibiotics morbidity in cases of intracranial sinusogenic complications reached approximately 80% [7, 20, 23], nowadays it is from 5% [25]. Permanent changes, such as epileptic seizures, palsy, impairment in mental function, etc., are observed in approximately 30% of the patients after intracranial sinusogenic complications [30].

Intracranial sinusogenic complications usually result from the topographical relationships between paranasal sinuses and the anterior and middle cranial fossae. That is why the spread of the infection to the cranium may be a potential danger related to inflammation within the sinuses. In most cases the origin of the complications is found within the inflammatory lesion in the frontal sinus, ethmoid cells, sphenoid sinus, less frequently – the maxillary sinus. It should be underlined that the source of the complications may be found within each paranasal sinus. These complications develop more frequently as a result of chronic exacerbated sinusitis. However, they may also develop in acute viral and bacterial sinusitis, through traumatic bone loss, incomplete endoscopic nose and sinus surgery or improperly performed procedures from the external approach [24,30]. The spread of infection via lymph vessels, preformed openings and canals, e.g. of the olfactory and optic nerve, cannot be excluded. The osseous wall that contacts the external layer of dura mater may exhibit inflammation or may be intact macroscopically. That is why brain abscess cannot be excluded if the osseous sinus wall is intact. Dura mater and cerebral cortex resist the inflammation for a longer period of time. Nevertheless, superficial changes, which may reach the white matter, develop over time. The inflammation of the cancellous diploë of flat osseous walls of the

cranium, in particular the frontal sinus, plays a significant role in the development of complications. A vast web net of venous vessels (veins of Brechet) forms a homogenous system of venous canals which is independent of the anatomical borders between the bones. They have numerous connections with veins of the skull sheath, dura mater veins, frontal lobe veins. Infected thrombi, which may comprise vast spaces of the diploë, may form inside these vessels due to the thinness of their walls, slower blood flow, lack of valves, close relationship to the mucous membrane of the osseous walls of the sinus affected by chronic purulent sinusitis. Osteomyelitic foci develop within the walls, most frequently in the frontal sinus, and their formation is accompanied by the development of fistulae or extensive bone tissue loss area filled with granulation tissue [14, 34]. Flat bones may be less resistant to inflammation in young patients, as in such patients cancellous matter inside the bones is thick. Therefore, these patients are more prone to the development of osteomyelitic intracranial complications. Sinusogenic subdural empyema, particularly in young males, may be the consequence of retrograde spread of the infection from septic marrow thrombophlebitis in the posterior wall of the frontal sinus [25].

Bacterial intracranial clinical syndromes that develop as a result of acute and chronic sinusitis include meningitis, cerebritis with a focal infection point, such as brain abscess, epidural empyema, subdural empyema and cavernous sinus thrombosis. Osteomyelitis within the frontal bone may lead to both extracranial complications (soft Pott's tumor) and intracranial complications [14, 31,33]. The variety of symptoms that accompany these complications result in wrong diagnosis and improper treatment. That is why, despite the advances in diagnosis and treatment, these complications remain a complex and difficult life-threatening clinical problem [9, 12, 14- 16, 22 - 24, 26, 33].

The prevalence of intracranial sinusogenic complication forms varies in the clinical material. Before antibiotics were used, the most common complications included meningitis and subdural empyema over the course of ethmoiditis, frontal and sphenoid sinus inflammation, which were always associated with high morbidity [7, 26]. Nowadays, brain abscesses and subdural empyemas are encountered more frequently, as they constitute 50% and 82% of all intracranial sinusogenic complications, respectively [6, 13, 26]. According to Singh et al. [26], subdural empyemas (127), brain abscesses (38) and meningitis (22) were commonly observed in the group of 219 patients with intracranial sinusogenic complications. According to the data provided by Clayman et al. [6], intracranial sinusogenic complications constituted 3.7% of the cases among 649 patients admitted to hospital due to sinusitis. Data concerning the incidence of intracranial sinusogenic complications were included neither in EPOS 2007, nor in 2012 [10, 11,14].

The clinical symptoms of intracranial sinusogenic complications may include non-specific syndrome of increased body temperature, headache, stupor, consciousness disorder, focal neurological symptoms, seizures etc. [25, 30].

AIM OF THE STUDY

The aim of the study is to analyze the patients with intracranial sinusogenic complications treated at the Dept. of Otolaryngology and Laryngological Oncology at the Poznan University of Medical Sciences from 2000 to 2013 including clinical symptoms, diagnostic and therapeutic methods, and treatment outcomes. Following factors were analyzed: age, sex, sinus-related symptoms and central nervous system-related syndromes, treatment before the patient was admitted to the Department, laryngological and neurological examination. Moreover, bacteriological examination of the purulent exudate acquired from the sinuses, epidural and subdural empyemas, cerebrospinal fluid and brain abscesses was performed. This study is a continuation of research into intracranial sinusogenic complications that was initiated in the Department in 1964. As the outcomes of previous research concerning the years 1964 – 1984 [27] and 1985 - 1999 [28] have already been published, patients with these complications from 2000 to 2013 were included in this article. It was prepared on the basis of direct observation, medical history, diagnostic imaging, outpatient charts and operating theatre patient records.

MATERIAL

Intracranial sinusogenic complications were diagnosed in 21 out of 4900 patients who underwent surgery due to paranasal sinusitis (0.43%). This group included 16 males (76%) and 5 females (24%). The patients were aged 13-72, mean value for age was 36. In the majority of cases, the complications affected males younger than 30. It should be underlined that the largest group of patients, i.e. 6 (29% of patients out of all patients with intracranial sinusogenic complications during the presented period), was observed in spring and autumn of 2013. As many as 1-2 people were treated annually from 2000 to 2012. The majority of patients were referred from neighboring laryngological departments, where antibiotic therapy had been introduced before the patients were sent to the Department.

Medical history taken from patients or their families revealed that 12 out of 21 patients (57%) had been treated for recurrent sinusitis – 4 had undergone surgery, 2 of them multiple times, and 1 patient out of them had already been admitted to hospital and underwent surgery 2 years earlier due to epidural abscess over the course of chronic inflammation of the right frontal sinus; epidural

abscess was observed in the same area. According to the medical history, symptoms such as mucous-purulent rhinitis, impairment in olfaction or anosmia, nasal congestion, strong headaches usually in the frontal and parietal area, with symptoms imitating influenza infection (78%), fever (74%), nausea and vomiting (33%) prevailed in the patients. Seven patients (33%) were unconscious at the moment of admittance to the Department. Dizziness and stupor, personality changes with behavioral changes were observed in 9 (43%) patients. Focal or generalized epileptic seizures were observed in 6 (29%) patients. Hemiplegia was observed in 7 (33%) patients. Neck stiffness was observed in 8 patients (38%). It was determined on the basis of the interview that brain abscess in one patient resulted from acute sinusitis over the course of acute lymphoblastic leukemia treatment. Necrosis of the upper eyelid was also observed in that patient. Thrombocytopenia was observed in 2 patients at admittance, one of female patient was treated chronically due to rheumatoid arthritis, one of the patients – due to autoimmune proctitis, while another patient was an alcoholic. Patients with deviated septum - 16 patients (76%) and carious teeth – 14 (67%) dominated in the group. Edema involving the soft tissues of the forehead was observed in 3 patients, and of the upper eyelid in 1 patient. Numerous polyp-like structures were observed in anterior rhinoscopy and endoscopic nose examination in 6 patients (29%). Nasal mucosa was swollen and reddened in most patients, which was frequently accompanied by the congestion of discharge under the inferior nasal concha and at the posterior part of the naso- and oropharynx.

Each patient with suspected intracranial sinusogenic complications was treated as an emergency case requiring immediate intervention involving diagnostics and treatment. Consultations by a neurologist, neurosurgeon, ophthalmologist and other specialists were performed according to accompanying diseases. The most important aims of the intervention were to diagnose the disease, and establish appropriate empirical intravenous antibiotic therapy. Immediately performed bone-window CT and/or contrast-enhanced MRI was the standard procedure. If lumbar puncture was performed, standard protocol included the examination of the cerebrospinal fluid with the qualitative and quantitative analysis of its components, bacteriological examination of the nose smear, biochemical blood tests including leukocytosis, erythrocyte sedimentation rate, CRP, procalcytonin level, thoracic radiograph and other examinations, according to the patient's state and coexisting diseases. Bacteriological examination was performed in order to culture microorganisms and to check the sensitivity of bacteria to antibiotics. In cases in which biopsy of areas affected by pathology, specimens acquired during surgery were sent for histopathological examination.

After the results of bacteriological test were obtained, preliminary empirical antibiotic therapy was altered, always after a consultation with a clinical microbiologist. Third generation cephalosporins, metronidazole, vancomycin, aminoglycosides or other antibiotics were implemented, according to the sensitivity of bacteria.

Fig. 1. MRI of the head. Patient KZ, age: 20. Patient's chart no. 25260/2013. Three abscesses in the right frontal lobe, 38, 25 and 10 mm in diameter, respectively.

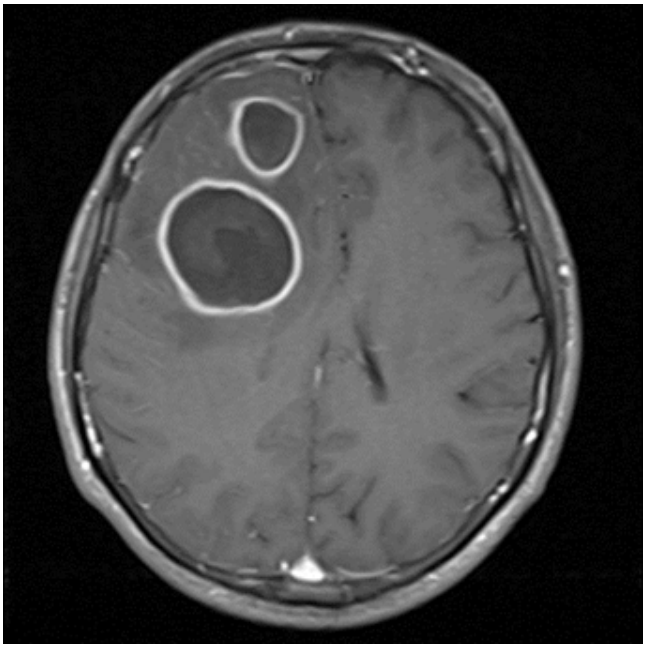

Fig. 2. MRI of the head. Patient ZK. Age: 21. Patient's chart no. 25228/2013. Two abscesses in the right frontal lobe, 41 and 26 mm in diameter. Thickened meninges above the area of the abscesses with 2 subdural empyemas of 12 and 10 mm in width and 6 mm thick. Pronounced mass-like effect observed as the compression and shift of the anterior horn of the right lateral ventricle.

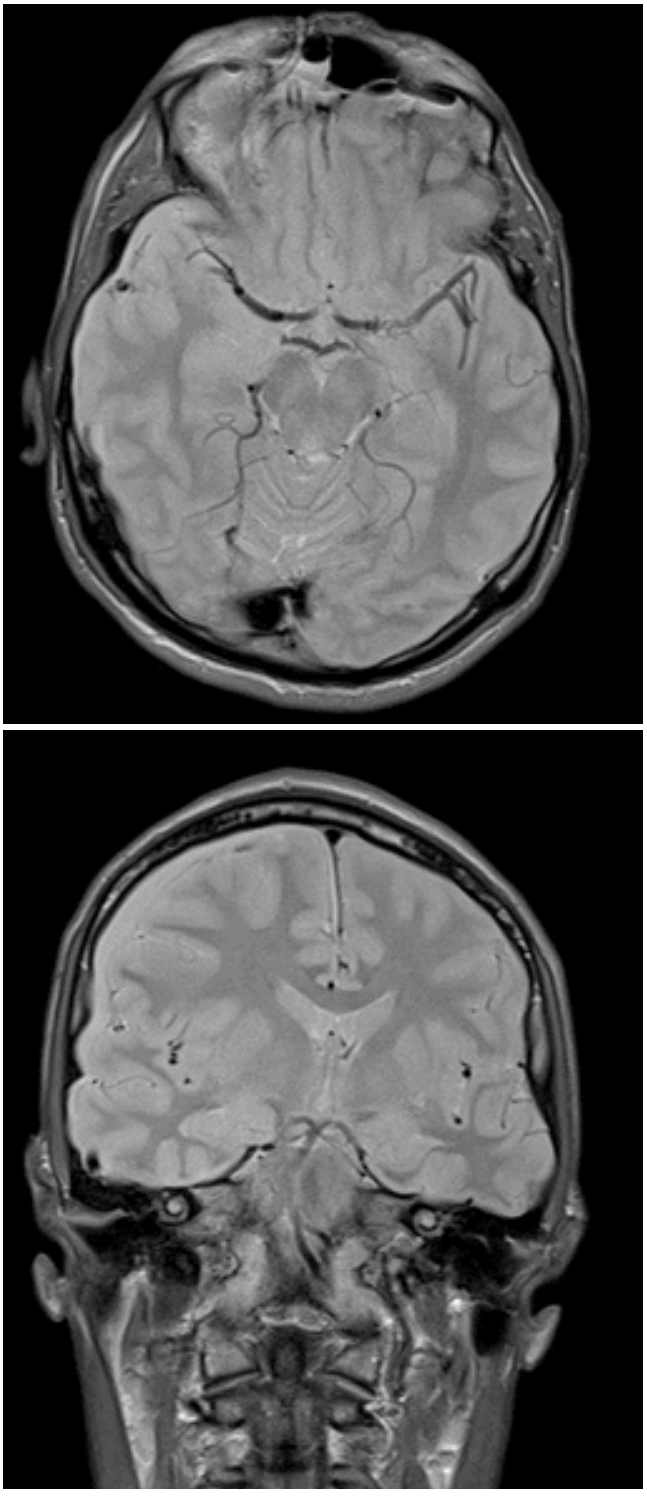

Fig. 3. MRI of the head. Patient B.G. Age: 23. Patient's chart no. 32828/2013. Epidural empyema in the area of right frontal lobe, maximum thickness of approximately 5 mm. Minor mass-like effect observed as a shift of the ventricular system to the left and compression of the lumen of the right lateral ventricle.

RESULTS

CT scans of the sinuses revealed bilateral multi-sinus inflammation in 6 patients (29%), unilateral in 7 patients (33%), and unilateral frontal sinusitis and ethmoiditis in 4 patients (19%). In other 4 patients (19%) with acute frontal sinusitis, the lesions were usually discrete and manifested themselves as decreased aeration of one frontal sinus and included ipsilateral lateral ethmoid cell involvement.

Among 21 patients with intracranial sinusogenic complications, 9 cases of frontal lobe abscesses (43%), 5 cases of epidural empyemas (24%), 4 cases of subdural empyemas (19%), 1 case of cavernous sinus thrombosis (5%), 2 cases of (10%) primary meningitis without other pathology within the central nervous system were observed. It should be underlined that these complications developed rarely in isolation, the coexistence of the complications with other intracranial sinusogenic complications was observed more frequently (Fig. 1, 2, 3). Among 9 patients with frontal lobe abscesses, purulent meningitis was observed in 2 of them, 1 of whom had multiple abscesses within the frontal and parietal lobe. In the following patient, frontal lobe abscess was accompanied by multiple epidural and subdural empyemas, the empyema within the area of falx cerebri, and meningitis. Subdural empyema was observed in one patient with epidural empyema. Cavernous sinus thrombophlebitis was accompanied by meningitis. In 6 patients with meningitis, 4 cases were caused by Staphylococci and Streptococci, in 2 cases the culture of the cerebrospinal fluid was germ-free.

All patients underwent surgery as emergency intervention, after all necessary laboratory tests were performed and their results acquired up to 12 hours after admittance to the Department.

According to paranasal sinus CT scans and brain MRI, preliminary treatment included a rhinosurgical microscopic or endoscopic procedure (FESS) performed in order to remove the hypertrophy of the nasal mucosa, purulent exudate from the sinuses, and in order to clear their natural ostia, especially the frontal recess. The extent of the surgical procedure corresponded with the lesions within the nose and the sinuses. In justified and severe cases, the frontal sinus was opened using the incision to the ciliary arch. The inflammation of the external layer of dura mater and epidural empyema usually developed in the areas in which the osseous wall of the sinus adhered tightly to dura mater. That wall was ischemic, frequently covered with granulation tissue; in some areas tissue loss was also apparent. If there was a lesion affecting the posterior wall of the frontal sinus, the surgeon had to uncover dura mater in order to search for epidural empyema. After removing its posterior wall and disclosing dura mater within the anterior cranial fossa, the epidural empyema and/or subdural

empyema was evacuated. The so-called closed treatment using Zakrzewski's method was used for brain abscess drainage. In this method, the abscess is punctured and its contents are gradually replaced with progressively decreasing concentrations of weak crystalline penicillin solution in physiological saline [33]. Then, constant pressure is kept inside the abscess cavity. This method is the least traumatic for cerebral tissue. Abscess drainage was possible if the abscess got encapsulated. The number of puncture sites corresponded with the size of the abscess and the result of the control MRI scan, neurological state of the patient, and involved usually 2-3 punctures. Healing of the abscess after a single puncture and replacement of its contents have been observed in the material of the Department. Control MRI scans were acquired with respect to the patient's state, on the average 10-14 days after the removal of abscess content removal. Neuronavigation has been used for performing injections to intracerebral abscesses at the Department since 2007. It enables to locate and evacuate the abscess. Neuronavigation is particularly useful in cases in which the abscess is located further away from the meninges of the anterior cranial fossa. Cooperation between a neurosurgeon and a laryngologist was required in one patient with subdural empyema in the area of falx cerebri. Craniopuncture was performed and followed by craniotomy with the evacuation of the interhemispheric empyema and drainage. Small abscesses (i.e. < 1cm) within the frontal and parietal lobes were treated using an MRI-guided intravenous antibiotic therapy. Carious teeth were extracted in 4 patients with odontogenic sinusitis. Rhino- and neurosurgery was performed always with broad-spectrum intravenous antibiotic therapy.

Septic cavernous sinus thrombophlebitis accompanied by meningitis was observed in one female patient. Bacteria present in the sphenoid sinus and ethmoid cells led to extremely severe septic cavernous sinus thrombosis with high fever, tremor, headache, pain within the orbit, edema of the eyelids, starring of the eyeballs, edema of the conjunctivae, and progressive vision impairment. The treatment in that patient included opening of paranasal sinuses, which were affected by inflammation, and intravenous administration of broad-spectrum antibiotics in high doses, according to the antibiogram. Moreover, the treatment included monitoring of the liquid balance and administration of anticoagulant drugs (heparin). Antibiotics were administered for the following 4 weeks.

Both aerobic and anaerobic bacteria were isolated in the same amounts from brain abscesses, epidural empyemas and subdural empyemas. Paranasal sinus flora dominated in epidural and subdural empyemas – in most cases the isolated bacterial species included Staphylococcus aureus and Streptococcus pneumoniae. Infection with anaerobic flora (Bacteroides spp., Propionibacterium spp., Fusobacterium spp), also Pseudomonas aeruginosa, was the predominant infection in brain abscesses. The culture of the abscess contents was germ-free in 20% of the cases. Antibiotic therapy continued for 4 weeks. Intravenous administration of antifungal medications was also included in the treatment. In patients with brain empyemas corticosteroids were generally not used. Corticosteroids were administered in exceptional cases to patients with significant edema of the cerebral brain tissue that surrounded the abscess with accompanying mass effect and increased intracranial pressure.

Post-operative course of the patients was generally good. No death occurred in the analyzed period. Recovery was observed in almost all patients. Epileptic seizures were observed in 2 patients with subdural empyemas and frontal lobe abscesses. They required further outpatient neurological care.

DISCUSSION

Although the methods used for treating acute and chronic sinusitis are often varied, methods used for the treatment of intracranial complications must be explicit, unequivocal and performed in emergency mode. The aim of the treatment is to remove the focus of inflammation within the sinuses, as well as to remove inflammatory intracranial lesions. Usually, the preliminary procedure involves rhinosurgery, mostly endoscopic, performed on the inflammatory lesions within the sinuses, with the removal of intracranial purulent foci performed at the same time. If the brain abscess within the frontal or parietal lobe was in the proximity of the dura mater, its removal was performed at the same time after the osseous focus in the sinuses was removed. The procedure was always performed with neuronavigation guidance. In cases in which the abscess was located further away from the dura, surgery was performed together with a neurosurgeon. All procedures were performed after broad-spectrum antibiotic therapy was implemented.

Epidural empyemas, observed between the internal surface of the posterior osseous wall of the frontal sinus and the dura mater, were observed in the area in which the osseous wall adhered tightly to dura mater. This inflammatory contact led to the transmission of the infection to dura mater with the development of empyema within the epidural and/or subdural space. Epidural space is a potential space and does not exist in physiological conditions. Physiologically, dura mater adheres to the surface of skull bones and separates from the bone as infection develops. The observed epidural empyemas were generally not that extensive, and their clinical symptoms were less eventful. The basic clinical symptoms of these complications included increased body temperature, headaches, epileptic status and focal negative symptoms, while 2 patients exhibited edema of the forehead.

Bone-window CT and MRI played a significant role in the diagnostics of epidural empyemas. In CT, the empyemas were visible as hypodense lentoid-shaped foci, whereas in MRI they were visible as fluid cisterns. During surgery, the osseous focus within the paranasal sinuses was usually removed and the epidural empyema was opened, and, usually, eliminated while removing the posterior wall of the frontal sinus.

Subdural empyema was observed much more frequently in young males. This may be related to the differences in the structure of paranasal sinuses and the frontal bone, particularly its cancellous matter. Subdural empyema in inflammatory lesions is a container of pus found between the parietal and visceral layer of the arachnoid, which form the arachnoid space [33], bordering directly with subarachnoid space. Subdural empyema usually develops through the inflammation of the frontal or another sinus, it may also spread from epidural empyema. It should be underlined that the evolution of this complication of sinusitis in the presented material was extremely violent, and the state of the patient got worse every hour. Subdural space is vast and contains few barriers that would stop the infection from spreading. Both layers of the arachnoid, which form the borders of this space, can limit the purulent process and stop the spread of infection by reacting to pathogens from the adjacent osseous focus and by forming adhesions. Inflammatory lesions within the subdural space usually developed in superior and anterior parts of the frontal lobe within one hemisphere. Later, they spread in the posterior direction. In the presented material they were accompanied by epidural empyemas, meningitis, brain abscess and intracranial venous thrombosis. From the clinical viewpoint, new subjective and objective symptoms from the central nervous system, i.e. focal negative neurological lesions, epileptic seizures, neck stiffness, increased intracranial pressure and contralateral hemiplegia accompanied sinusitis complicated by subdural empyema. Lumbar puncture was avoided in patients with diagnosed or suspected subdural empyema, as this procedure does not provide any significant information and is associated with the danger of brain herniation. Neck stiffness was an atypical symptom for subdural empyema and brain abscesses, it suggested the possibility of the development of subdural empyema, particularly in cases in which focal neurological symptoms and increased body temperature were observed. Cooperation between the neurologist and the neurosurgeon was inevitable in these cases.

Sinusogenic bacterial meningitis as acute purulent infection within the subarachnoid space was associated with inflammatory reaction of the meninges causing impairment in consciousness, epileptic seizures and increase in intracranial pressure. In cases in which focal neurological symptoms were observed, MRI scans were crucial while looking for lesions within the central nervous system. The course of meningitis was milder in cases in which it was accompanied by other intracranial complications. Surgical treatment of primary sinusogenic meningitis forms involved opening the osseous bacterial focus in paranasal sinuses.

Sinusogenic brain abscesses, usually within the frontal and parietal lobes, constitute the focal infections in the cerebral tissue. They constitute 10-13% of all brain abscesses. They were observed in fewer cases than otogenic abscesses; nevertheless, the former surpassed the latter when it comes to severity [29, 33]. In immunocompetent patients, tight brain-blood barrier and good vascularization of the meninges makes cerebral tissue relatively highly resistant to infection. However, in case of bacterial invasion, brain tissue reacts in a certain way [22,30]. In the first stage, cerebral tissue inflammation (cerebritis) develops [25], and finally, an organized and encapsulated abscess develops. Brain abscess was characterized by the presence of a growing intracranial mass-type lesion and inflammation. The evolution of subjective and objective symptoms was varied, and the complaints reported by the patient lasted from a few days to a few weeks. The clinical manifestation of the abscess depended on its location within the frontal or parietal lobe, the time of development, the type of infection, the increase in intracranial pressure and the coexistence of other intracranial complications. The symptoms observed most frequently for this location included headache, usually constant and dull, low-grade fever, negative neurological symptoms, epileptic states, personality changes, impairment in orientation, stupor and sleepiness. Contralateral hemiplegia was observed in brain abscesses that were diffuse and located deeper within the frontal and parietal lobes. Brain MRI scans made it possible to determine the location of the abscess, its shape (simple, multiloculated, multiple abscesses), the state of its capsule, the edema of the brain cerebral tissue surrounding the abscess, the presence of accompanying epidural and subdural empyemas, and to monitor treatment efficacy. MRI was superior over CT in the visualization of abscesses at their early stages of development. A mature abscess exhibited an enhancing capsule which surrounded the hypodense center and which was surrounded by a hypodense picture of the brain edema. Aerobic, anaerobic bacteria and fungi were cultured after purulent exudate was acquired from the abscess.

Frontal lobe abscesses of the brain were observed in 9 patients between 2000 and 2013, in whom intracranial sinusogenic complications were observed. This number constituted 43% of complications of sinusitis from that time period. These abscesses were followed by epidural – 5 (24%) and subdural – 4 (19%) abscesses. Brain abscesses have prevailed in the material comprising patients with intracranial sinusogenic complications at the Dept. of Otolaryngology in Poznan since 1964 [27,28]. Frontal lobe abscesses were diagnosed in 23 (50%) of all 46 patients with intracranial sinusogenic complications. Thus, they constitute the largest group of patients with intracranial sinusogenic compli-

cations. A similar tendency for the incidence of brain abscesses in intracranial sinusogenic complications is reported by other authors[6, 13, 15, 26].

The use of anticoagulation therapy in cavernous sinus thrombosis is controversial. It seems, though, that the administration of heparin in appropriate doses, removal of the inflammatory focus in the paranasal sinuses, broad-spectrum antibiotic therapy and proper hydration are beneficial and enable a satisfactory recovery for the patient.

The combination of symptoms such as headaches, fever, focal neurological symptoms and paroxysmal activity, all of which progress rapidly to impairment in consciousness, the differential diagnosis should include viral meningitis and cerebritis, other forms of bacterial meningitis, cerebral vessel thrombosis, disseminated encephalomyelitis, abscesses of other origin – e.g. otogenic or hematogenous. If fever is not observed, differential diagnosis should include mainly primary and metastatic brain tumors, strokes and subdural hematomas.

CONCLUSIONS

Intracranial complications of sinusitis were observed both in acute and chronic exacerbated sinusitis. They constituted 0.43% of 4900 patients treated surgically due to sinusitis in the analyzed material comprising 13 years. Frontal and parietal lobe abscesses were the most common sinusogenic intracranial complications in the analyzed time period. In the years 2000 – 2012 approximately one patient with sinusogenic intracranial complications was treated at the Department annually. The fact that 6 patients reported in 2013 could have been related to an exacerbation in sinus infection during the influenza infection at that time.

Intracranial sinusogenic complications were observed more frequently in young males. They were observed either in isolation or were accompanied by other intracranial complications.

Subdural empyemas were characterized by extremely severe development and severe clinical course, which may result from the existence of subdural space which does not contain any barriers that would stop the infection from spreading.

Streptococci, Staphylococci and anaerobic bacteria were the most frequently encountered pathogens in intracranial sinusogenic complications.

CT and MRI are nowadays the most reliable and the least invasive methods for diagnosing and monitoring intracranial complications.

Endoscopic removal of inflammatory lesions within the nose and sinuses with simultaneous evacuation of the intracranial purulent exudate was considered the typical treatment for intracranial sinusogenic complications. Frontal lobe abscesses and subdural abscesses were treated mainly with the use of the closed method which involved progressive drainage of the lesions. This method has been used at the Department of Otolaryngology of the Poznan University of Medical Sciences for over 60 years. The efficacy of the treatment can be increased by neuronavigation.

A 100% success rate was observed in the analyzed period. Early diagnosis of sinusogenic complications and implementation of antibiotic therapy, as well as simultaneous performance of nose, sinus and intracranial surgery, plays a significant role for saving the patient's life.

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