Chronic odontogenic paranasal sinusitis in the material provided by the Otorhinolaryngology Unit of the 4th Military Teaching Hospital in Wrocław

Przewlekłe zębopochodne zapalenie zatok przynosowych w materiale Poradni Otolaryngologicznej 4. Wojskowego Szpitala Klinicznego we Wrocławiu

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Abstract

Background. The aim of this work is to prepare a dental diagnostic standard that would enable us to distinguish patients with chronic odontogenic sinusitis (COS) from patients with sinusitis of other origin. We also wanted to determine a realistic number of COS in the Polish population.

Objectives. The diversity of symptoms presented in COS does not differ from chronic sinusitis of other origin. However, the microbiological and pathophysiological differences extort a specific diagnostic approach and treatment. This is why odontogenic sinusitis is considered to be an independent disease. The basic method used to diagnose odontogenic foci is an orthopantomogram (OPM), but CB-CT is currently becoming a more common option. A proper diagnostic route enables correct problem identification and implementation of the best treatment method. Endoscopic sinus surgery (ESS) is an effective way of treating up to 85% of patients. Postoperative lack of success may be associated with odontogenic foci, which is why it is highly important to exclude this infection focus in the preliminary qualification for surgery.

Material and methods. Our study group consisted of 72 patients preliminary qualified for ESS on the Otolaryngological Unit of the 4th Military Teaching Hospital in Wrocław because of chronic sinusitis. Patients after initial qualification were referred to dental surgery outpatient clinic for exclusion of potential odontogenic changes. The evaluation was performed by a group of qualified doctors and based on a clinical examination and radiological imaging (sinus CT, orthopantomogram, other radiograms). Acquired data was analyzed statistically.

Results. Odontogenic foci were found in 86.1% patients (62 cases) with chronic sinusitis. Lack of odontogenic foci was stated only in 13.9% patients (10 cases). There were no statistical differences in the number of inflammatory foci between men and women.

Conclusions. The lack of treatment standards in COS forces us to create good interdisciplinary preoperative cooperation between head and neck surgeons, radiologists and chronic sinusitis

Key words: chronic odontogenic sinusitis, odontogenic complications, endoscopic sinus surgery

Słowa kluczowe: przewlekłe zębopochodne zapalenie zatok, powikłania zębopochodne, endoskopowa operacja zatok

The sinonasal mucosa constitutes a morphological and functional whole. Paranasal sinusitis is a disease with a complex etiology; however, bacterial biofilm and the obstruction of the ostiomeatal complexes constitute the main pathogenic factors. Untreated local inflammatory process in one space begins to spread, eventually encompassing the remaining structures. Of all the sinuses, the maxillary sinuses are the largest and they are most commonly affected by inflammation. Possible etiology includes both local and systemic factors.

Sinusitis may be acute, subacute or chronic. The first two types are usually related to an infection or nasal allergy, though the growing role of odontogenic infections is frequently mentioned among the etiological factors of chronic sinusitis.¹ The division and treatment of individual inflammatory states are presented in numerous papers, prepared by groups of rhinologists. In Poland, EPOS is used, the last version of which dates back to 2012.²

Chronic paranasal sinusitis is an inflammatory state of the nasal mucosa and paranasal sinuses characterized by the presence of two or more symptoms, one of which is defined as nasal obstruction or runny nose and the other as the lack of the sense of smell, lasting for more than 12 weeks. Moreover, X-ray images and endoscopic examinations should also reveal changes.

The impact of odontogenic periapical lesions on inflammatory changes in the maxillary sinus was described in 1943 by Bauer.³ During the microscopic examination on corpses, tooth samples as well as samples of sinuses and alveolar processes were investigated. It has been proven that odontogenic inflammatory changes related to the mucous membrane may appear regardless of the damage inflicted to the cortical plate of the floor of the sinus. Odontogenic sinusitis is described as a reactive inflammatory process of the maxillary sinuses, secondary to tooth infection, tooth and alveolar process damage, tooth extraction, procedures carried out within the area of the alveolar process or endodontic treatment, which may affect the integrity of the Schneiderian membrane.

Maillet et al.⁴ have recently defined radiological criteria for odontogenic changes within the maxillary sinus as "local thickening of the maxillary sinus mucosa related to extensive tooth decay or dental filling, with co-existing periapical change, or a tooth, whose condition precludes the implementation of a dental treatment." Based on a CB-CT analysis, Maillet et al.⁴ assessed that almost 50% of changes in the maxillary sinus area are related to odontogenic foci.

Odontogenic maxillary sinusitis (OMS) is one of the earliest detected causes of paranasal sinusitis, which is completely different in etiology from the remaining types.¹ For almost 100 years, it has been estimated that odontogenic sinusitis constitutes approximately 10% of all inflammatory diseases.⁵ The advancement in X-ray and endoscopic technology has led to a situation in which odontogenic etiology is identified as the main cause of sinusitis in almost 40% of all cases.⁵

Odontogenic infections spread either directly from the oral cavity, once the maxillary sinus floor is damaged, or indirectly by the alveolar process of the jaw, through the Haversian and Volkmannian canals.⁶ The inflammation starts in the alveolar recess of the maxillary sinus and then progresses, causing consequently an obstruction of the ostiomeatal complex and the involvement of the anterior ethmoidal sinuses, together with the frontal sinuses, at the side where the lesion occurs.

Wanyura et al. suggested dividing the odontogenic sinusitis into two types: primary and secondary.⁷ The primary type included complications from tooth decay, pulp necrosis and impacted teeth. The secondary type encompassed oro-antral communications, odontogenic cysts and other causes, such as foreign objects in the sinuses, root-related inflammatory processes and periodontal diseases. Some papers divide the tooth-related inflammatory states into iatrogenic and non-iatrogenic. The most common iatrogenic infections include post-implantation sinusitis.⁸ The remaining ones are related to the mechanical damage inflicted to the mucous membrane of the maxillary sinus, occurring as a post-effect of the root canal treatment, dental material being forced into sinuses or improper augmentation of the sinus.

Longhini et al. noted that in the literature devoted to paranasal sinusitis, published after 2010, odontogenic maxillary sinusitis (OMS) is being omitted as the cause of paranasal sinusitis.⁹ It also seems that oroantral communications, as well as post-extraction complications, including post-extraction alveolitis, are more and more often viewed as the underlying causes of acute sinusitis. In the remaining cases, odontogenic lesions lead to chronic sinusitis. The literature on this topic is inconclusive and the general access to the CT scan technology forced rhinologists to revise the well-established schemes concerning the etiopathogenesis that have been in use for numerous years. Therefore, the paper presented below refers primarily to the literature published within the last 7 years.

It is difficult to diagnose a tooth-related sinusitis, since the progression of the infection often takes place in a very slow manner, with few visible clinical signs and without any tooth pain experienced by the patient. Moreover, dental clinical examination may exclude the presence of odontogenic inflammation.

CT scans are most useful when assessing odontogenic sinusitis; however, radiologists do not always describe dental pathologies. Meanwhile, errors made during establishing the etiology of a mucosal inflammation and paranasal sinusitis lead to errors in the treatment – patients are qualified for endoscopic sinus surgery without the implementation of causal treatment.

Even though odontogenic sinusitis is a relatively common disease, its pathogenesis remains unclear. Until now, no consensus has been reached concerning the clinical approach, treatment and preventive actions that could be

taken to avoid the disease. The treatment of odontogenic paranasal sinusitis focuses on causes.

An odontogenic inflammatory process is a condition, the prevention and treatment of which should depend on, above all, dentists, especially given the fact that within the available literature, dental treatment complications constitute the main cause of OMS.

In light of the fact that the treatment is different from the one applied in other cases, odontogenic sinusitis is a separate disease. The treatment of chronic odontogenic sinusitis consists in a causal therapy, the goal of which is to eliminate odontogenic foci in the first instance. When pharmacotherapy is applied, one should remember that odontogenic sinusitis, as any odontogenic infection, is usually a heterogenous infection, in which both anaerobic as well as aerobic bacteria are involved. Antibiotic therapy is recommended mainly in the cases when the underlying disease flares up and when odontogenic abscesses appear.¹⁰ It may also be considered when the causal dental treatment is completed, to accelerate the recovery process. The available literature lacks in standards related to the period, throughout which antibiotics should be administered to patients with OMS.

As regards the odontogenic infections treated in a hospital, the parenteral use of penicillin is still the preferred method, with doses reaching even 20 million units per day. In the case of patients who are allergic to penicillin, clindamycin is a valid alternative.¹⁰ As far as surgical treatment is concerned, the Caldwell-Luc procedure should be considered. This would provide the surgeon with better access to changes present within the maxillary sinuses. In the case of oroantral communication, it is possible to perform the revision of the sinus cavity and its drainage, from the side of the oral cavity, with subsequent surgical procedure, aimed at closing the fistula. In some cases, endoscopic sinus surgery may be required. This would enable us to control and monitor all sinuses and to clean them under direct vision, with a low percentage of complications and relapses (if the underlying dental cause of the disease is eliminated).¹¹

In most patients who underwent treatment in the Department of Otorhinolaryngology of the 4th Military Teaching Hospital, the decision about an endoscopic sinus surgery had been based solely on a certificate issued by regional dental clinics, until the cooperation with an oral surgery unit started.

A vast number of relapses during the first several months following the surgeries impelled the doctors of the 4th Military Teaching Hospital to create standard dental preparation for sinus surgery. A group of doctors and dentists was properly trained to be able to assess odontogenic foci.

Material and methods

The sample group consisted of patients who were sent from regional ENT outpatient clinics to the Otorhinolaryngological Unit of the 4th Military Teaching Hospital in

Wrocław. Based on the initial diagnosis and radiological examination patients were preliminary qualified for the endoscopic sinus surgery under general anaesthesia.

Prior to the planned procedure, all patients were directed to the Oral Surgery Unit of the 4th Military Teaching Hospital to exclude the presence of odontogenic foci. Orthopantomography (panoramic radiography) was performed in all cases. The doctors also carried out thorough clinical and radiological examinations (CT scan of the paranasal sinuses).

From September 2014 to October 2016, the aforesaid procedures were performed on 147 patients. The group consisted of 73 women and 74 men aged 19–77, with lesions in the paranasal sinuses area visible on the CT scans of the paranasal sinuses, and with symptoms of chronic paranasal sinusitis. Following the initial otolaryngological examination, they were qualified for endoscopic sinus surgery. The patients also underwent dental examination, both clinical and radiological. Odontogenic foci were identified by means of panoramic X-ray images, as well as a detailed assessment of teeth, alveolar process and sinus cavity, based on a CT scan and clinical examinations.

The following aspects were considered during the assessment: periodontal inflammatory states, periapical changes, teeth that were subject to improper endodontic treatment, impacted teeth, and cysts related to teeth within the jaw. Next, the results underwent a statistical analysis, performed with the use of GraphPad Prism 7. The normality of distribution was measured by D'Agostino-Pearson test. The difference between groups was tested by Mann-Whitney test for quantitative variables and Fisher's exact test for qualitative variables. Correlation of selected parameters was tested by the Spearman test.

All patients without ostiomeatal complex obstruction and with odontogenic foci present in the alveolar process of the maxilla were offered surgical treatment via an intra-oral approach in the Oral Surgery Unit of the 4th Military Teaching Hospital. Prior to surgical treatment all patients underwent oral cavity sanitation.

Results

The average age of the patients was determined as 47.78 years (standard deviation $\pm$ 14.55). Women constituted 49.7% of the sample group (73 out of 147), whereas 50.3% of the subjects (74 out of 147) were men.

Odontogenic foci were detected in the case of 85.7% of the patients, i.e. 126 subjects. They were present in 82.2% of male and 89.2% of female patients. The lack of odontogenic foci was shown in the case of 14.3%. No significant differences in the number of odontogenic foci between male and female patients were found. 32.7% of the sample group had full dental arch. Dental profile of the group is presented on Fig. 1 and 2.

The results of the clinical and radiological examinations were as follows: 48.9% of all odontogenic foci were teeth

Fig. 1. Dental profile of the sample group – right maxilla

Fig. 2. Dental profile of the sample group – left maxilla

after improper endodontic treatment; 17.3% were roots remaining in the alveolar processes of maxilla; 9.1% showed inflammatory states in periodontium, visible on X-ray and in clinical tests. 7.4% of all odontogenic foci were impacted teeth that could potentially institute odontogenic foci (Fig. 3). 4.2% of foci consisted of endodontic material present in maxillary sinus lumen. In the case of two patients, dental roots were present inside the maxillary sinus and one patient was diagnosed with an oroantral fistula.

A radiological examination revealed that only 26.8% of all endodontically treated teeth have shown signs of proper endodontic treatment.

The relationship between the patients' age and the number of absent teeth exists in a positive correlation ($r = 0.708$). The older the patient, the fewer teeth remain. In the case of the subjects' age and the presence of odontogenic foci, no positive correlation was determined. The situation changes if we consider the fact that the absent teeth may have been extracted as an active odontogenic focus that may have caused sinusitis in the past. Then the age and the amount of odontogenic foci increased by the number of removed teeth stay in a positive relationship with one another ($r = 0.67$).

Another positive correlation exists between the amount of odontogenic foci, extracted teeth and teeth after endodontic treatment ($r = 0.674$). Endodontic treatment was usually performed also because the tooth is a dental focus.

In the entire group of 147 people, 16 patients (10.9%) underwent an endoscopic sinus surgery more than once. 15 patients were diagnosed with multiple odontogenic foci after a detailed clinical and radiological examination of the oral cavity. 30 patients (20.4%) were treated in the Oral Surgery Unit of the 4th Military Teaching Hospital. In this group, 10 subjects underwent maxillary sinus surgery via an intraoral approach. This has proven to be the only treatment needed in this group. All other patients underwent or await an endoscopic sinus surgery under general anesthesia in the Otorhinolaryngological Unit of the 4th Military Teaching Hospital.

Discussion

To our knowledge, there are no publications that would present a similar group of patients, so it is difficult to refer to results obtained by other authors.

Fig. 3. Distribution of patients according to odontogenic foci

The existing literature shows that the presence of inflammatory changes on the X-ray image is indicative of odontogenic aetiology, present in approximately 70% of all cases.¹² In a group of 172 patients, Troeltzsch et al.¹³ diagnosed the underlying odontogenic causes in 92.5% of all cases, whereas the most common cause was post-dental treatment complications (75% of all cases). The fact that the disease involved one or both maxillary sinuses cannot be the main diagnostic criterion since in most cases, the inflammatory process develops and affects the remaining paranasal sinuses.¹⁴

Bomeli et al. noted that 79% of all cases of acute maxillary sinusitis may be related to the presence of an odontogenic focus.¹⁵ The development of the X-ray technology, as well as the availability of CT scans led to a situation in which it is currently estimated that almost 86% of all cases of sinusitis may have an odontogenic character.¹⁶ These results correspond with the percentage shown in our sample group – 86.1%.

Longhini et al. indicated a group of patients with acute sinusitis who received surgical treatment.¹⁷ The treatment was ineffective until odontogenic foci were removed. They also noted that in some cases, dentists who performed clinical tests and OPG excluded the potential presence of teeth-related pathologies. The changes were confirmed only by CB-CT scans.¹⁷

Obayashi et al. noted that 71.3% of tooth infections related to the jaw were associated with changes in the maxillary sinus.¹⁶ What is important, in most cases, the clinical tests ruled out the presence of odontogenic infections. These were only diagnosed with CT scans. Wang et al. carried out a retrospective analysis of 55 patients, where chronic odontogenic sinusitis was diagnosed and teeth-related pathologies were recorded and confirmed by computer tomography.¹⁸ These authors noted that in 65% of all cases, the radiological description did not consider odontogenic pathologies. Longhini et al.¹⁷ noticed a similar problem in 67% of cases.

While reviewing the literature on chronic odontogenic sinusitis, Lechien et al. stated that almost 67.5% of cases have an iatrogenic background.¹⁹ Etiological meta-anal-

ysis developed by Arias-Irimia et al., performed on 770 patients with odontogenic paranasal sinusitis, described in 41 articles written between 1986 and 2007, showed that women constitute 57.7% of all patients suffering from odontogenic paranasal sinusitis.²⁰ 55.97% of patients presented odontogenic changes of an iatrogenic profile. Periodontal disease was detected in 40.38% of the patients, while 6.66% of the patients exhibited odontogenic cysts. Because the qualification of odontogenic foci was based mostly on X-ray techniques, which are not currently recommended, we may assume that the above results are understated. However, the results concerning the sex are virtually identical to those of patients treated in the 4th Military Teaching Hospital (with 53% of cases with a iatrogenic aetiology). Nonetheless, the statistical analysis shows that there are no significant differences in the number of foci between men and women in the sample group. A reduced sensitivity of X-ray techniques could have an impact on significant discrepancies between the percentage of iatrogenic changes that were detected (ranging from 57.7% in the Arias-Irimia et al. study to 83.87% in the case of the research carried out at the 4th Military Teaching Hospital).

The available literature lists complications after the insertion of dental implants as the most common cause of odontogenic maxillary sinusitis (OMS).⁸ However, the sample group did not include any patients who underwent the aforesaid procedure. It is also quite difficult to assess the actual percentage of the oroantral communications, since patients suffering from this condition are usually directly sent to a maxillofacial surgery unit and not to the otorhinolaryngological departments.

Rodrigues et al. notes that the lack of teeth in the maxilla does not rule out odontogenic changes as the cause of sinusitis.²¹ Endodontic materials, fragments of tools left after root canal treatment or even root fragments may all provide favorable conditions for the sinus inflammation to develop.

Recently, it has been agreed that the obstruction of the ostiomeatal complex is an essential factor in the pathogenesis of sinusitis. This led to a situation in which endoscopic sinus surgery, which helps to both cleanse the sinuses and widen the ostiomeatal complex, has a signifi-

cant advantage over other surgical methods used in the treatment of chronic sinusitis. Endoscopic treatment and the significance of nasal septum, tonsils and adenoids, which is related to the patency of the ostiomeatal complex, led to the marginalization of the role of maxillofacial surgeons who use, above all, the classic access point, located within the front wall of the maxillary sinus. When the qualification for a surgical treatment is carried out properly, patients with sinusitis secondary to oroantral fistula and odontogenic sinus cysts are referred to maxillary surgeons. Patients showing symptoms of acute sinusitis, for whom a sinus puncture supported by antibiotics is the preferred treatment, are usually attended in an accident and emergency pathway. A similar situation may be observed in the case of patients suffering from chronic sinusitis, who are treated in the 4th Military Teaching Hospital. Thus, based on this group of patients, it is only possible to determine the scale of the problem related to odontogenic infections in patients suffering from chronic sinusitis. The real percentage of cases with sinusitis may be, in fact, decisively larger than the one described in this paper.

In the case of advanced changes in numerous sinuses, it is very difficult to determine whether the dental condition constitutes the primary etiologic factor. However, there is no doubt that the presence of odontogenic foci intensifies the inflammatory processes, contributing to the loss of the effectiveness of both preventive and surgical methods of treatment, which results in relapses.

Regardless of this, the scale of the problem shows the key role dentists play both when it comes to the prevention and treatment of acute sinusitis. Meanwhile, a consistent lack of diagnosis of odontogenic foci in the studies devoted to the treatment of sinus problems, published in papers recommended by rhinologic associations, seems to have an influence on the low success rate of the treatment administered to patients with sinusitis, which constitutes a social problem. Low efficiency of endodontic treatment indicates that not only diagnostic but also dental treatment quality has to be improved and controlled on X-rays periodically.

Incorrect interpretations of CT scans by dentists and of pantomograms by laryngologists expose patients to ineffective treatment of sinusitis.

Conclusions

Bearing in mind that there are no standards for the treatment of chronic odontogenic paranasal sinusitis, it seems that it would be a good solution to establish a pre-surgical, inter-disciplinary cooperation between the hospitals (maxillofacial surgeons, laryngologists, radiologists) and outpatient clinics (dentist practices), covering crucial areas, mainly raising awareness among dentists and patients regarding the significance of odontogenic foci in the aetiology of recurrent chronic sinusitis. Establishing a diagnosis of odontogenic foci based only on a clinical examination should no

longer be recommended. Dentists must be trained in the assessment of odontogenic changes in OPG and CT scans. The standard examination to qualify a patient for sinus surgery should be CT, which makes it possible to review the condition of the teeth and paranasal sinuses.

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