CLINICAL CASES

Dent. Med. Probl. 2015, **52**, 2, 235–240
ISSN 1644-387X

Yevhen Viktorovich Kuzenko[A, C–D], Anatoly Mykolayovych Romaniuk[F]

Odontogenic Inflammation Complicated by an Abscess of the Brain – Case Report

Zapalenie zębopochodne powikłane ropniem mózgu – opis przypadku

Department of Pathology, Medical Institute of Sumy State University, Sumy, Ukraine

A – research concept and design; **B** – collection and/or assembly of data; **C** – data analysis and interpretation; **D** – writing the article; **E** – critical revision of the article; **F** – final approval of article

Abstract

We describe a case of brain abscess due to odontogenic infection. In this report, a 73-year-old female patient was admitted to the maxillofacial department with an odontogenic abscess of the chin area complicated by immunosuppression. In the year 2014, the patient had been treated 3 times. Even after several routine tests, we still could not treat the abscess. However, after an immunogram, immunosuppression was found. Life support and treatment was not successful and she died. Oral pathogens from an odontogenic infection could enter the brain via either a hematological link. Cerebral abscesses are frequently polymicrobial. All available literature is in the form of small case studies. Cerebral abscess linked to odontogenic infection is a rare occurrence since in most individuals the blood-brain barrier along with the immune response will keep bacteria out. Odontogenic infections in the pathogenesis of a cerebral abscess are as a result of immunosuppression and somatic pathology. Management of these life-threatening infections depends on the location and the dimensions of the lesion, as well as on the level of medical alertness (**Dent. Med. Probl. 2015, 52, 2, 235–240**).

Key words: immunosuppression, abscess of the brain, odontogenic inflammation.

Słowa kluczowe: immunosupresja, ropień mózgu, zapalenie zębopochodne.

Non-traumatic brain abscess is mostly caused by hematogenous spread of a distant focus of infection. Absence of a clear source of infection is reported in as many as 40% of cases [1]. Brain abscesses are usually due to continuous infections such as sinusitis, ear infection and odontogenic infection [2]. The commonest emergency odontogenic infections are periapical abscess (25%), pericoronitis (11%) and periodontal abscess (7%) [3]. *Fusobacterium necrophorum* is the most common etiologic agent (70–80%) of odontogenic infection, although other pathogens or mixed odontogenic infections have been reported (*Bacteroides fragilis, Staphylococcus epidermidis* and *Enterococcus spp.*) [4]. Of all of the various periodontal pathogenic bacteria that colonize the mouth, there are *Porphyromonas gingivalis (Pg), Tannerella forsythia (Tf),* and *Aggregatibacter actinomycetemcomitans (Aa)* that have been implicated as etiologic agents in periodontal infections [5]. Oral pathogens from an odontogenic infection could enter the brain via either a hematological link (facial, angular, ophthalmic artery, spread through the cavernous sinus), or a lymphatic link, or by direct extension through the fascial planes [6]. We report a case of brain abscess of dental origin in the case of a patient with immunosuppression and concurrent somatic pathology (chronic liver disease, bronchial asthma and essential hypertension).

Case Report

On July 25th, 2014, a 73-year-old female patient was admitted to the maxillofacial department in Sumy Regional Hospital with an odontogenic ab-

scess of the chin area. She had been diagnosed with chronic bronchial asthma (ICD-10 Version 2015 – J45.9) 40 years previously. Her family history revealed cases of asthma among her father and brother. The bronchial asthma had been treated. A complete dental examination showed multiple periodontal inflammations in tooth 34, 35, 36 and 46. Those teeth were extracted. A Panoramix x-ray showed a change of signal intensity in the mandible – oval focus 1.5 × 1.8 cm (Fig. 1). The root of tooth 33 was connected with a dentoalveolar periapical cyst (ICD-10 Version 2015 – K04.8). The cyst and tooth 33 were extracted. The cyst cavity was filled with osseous material (Kollopan®). On August 2nd, 2014, she was discharged after therapy (Ceftriaxonum® 2 g per day; Lorano® 10 mg per day; Linex® 1 capsule three times a per day).

On September 9th, 2014, the patient was readmitted to the maxillofacial department in Sumy Regional Hospital with a submandibular abscess (ICD-10 Version 2015 – K12.2). It had carried release of pus. The submandibular abscess was washed by Decasan 0.02% – 3 mL 3 times per day. The patient received therapy: Metronidazolum 500 mg – 100 mL 2 times per day; Magniisulfas 20% – 5 mL 1 time per day; Gatifloxacin® 400 mg – 200 mL 1 time per day; Linex 1 capsule 3 times a per day. On September 23rd, 2014, she was discharged after treatment and improvement of her condition.

On September 30th, 2014, the patient was hospitalized for the third time. A subacute submandibular abscess was diagnosed (ICD-10 Version 2015 – K12.2). The abscess was a complicated mandibular osteomyelitis. It had carried release of pus. The submandibular abscess was washed by Decasan 0.02% – 3 mL 3 times per day. On September 31st, 2014, she was operated on with the purpose of drainage of the abscess. The patient received therapy: Tienam 500 mg – 100 mL 2 times per day; Ornigil 500 mg – 100 mL 1 time per day; Reosorbilac 200 mL 1 time per day; Blood plasma 100 mL 2 times. For further diagnostic purposes, the patient had an immunogram performed. Immunosuppression was identified during examination.

Asthma had led to immunosuppression. These results showed white blood cell count of $4.1 \times 10^9/mm^3$ with a differential count of 80% segment cells, 10% lymphocytes, 6% mono and 4% nonfilamented neutrophil. The erythrocyte sedimentation rate (ESR) was 11 mm/h. Immune complexes were: level I – 16 cu, level II – 60 cu and level III – 390 cu. The patient's body temperature was 36.6°C. Between October 1st, 2014 and October 5th, 2014, the patient received antibiotic therapy and care for the abscess incision but with no positive effect. On October 6th, 2014, the patient developed brain disorders (profound depression of consciousness with loss of voluntary and preservation reflex activity) and soon became drowsy. The physician ordered MRI (Fig. 2) and CT (Fig. 3) scans. The MRI showed a change of signal intensity in the right occipital lobe – oval focus 3.0 × 2.0 cm. After contrast injection accumulated in the membrane 0.4 cm, edema was noted in the brain. The CT scan confirmed the MRI data. Based on the CT and MRI data, the patient was diagnosed with "Brain abscess (embolic) of right occipital lobe" (ICD-10 Version 2015 – G06.0).

Between October 6th, 2014 and October 9th, 2014, the patient fell into a coma and did not show positive dynamics. The patient developed muscle rigidity. Life support and treatment were not successful and she died. The blood parameters are shown in Table 1.

Autopsy

When acute odontogenic infection is accompanied by intense neutrophilic infiltrates in the inflamed tissue, it results in tissue necrosis. The formed cavity is called an abscess (Fig 4). The membrane of the brain, the dura mater, had a green color and strong thickness. In the pia mater, blood vessels had filled. We observed pus

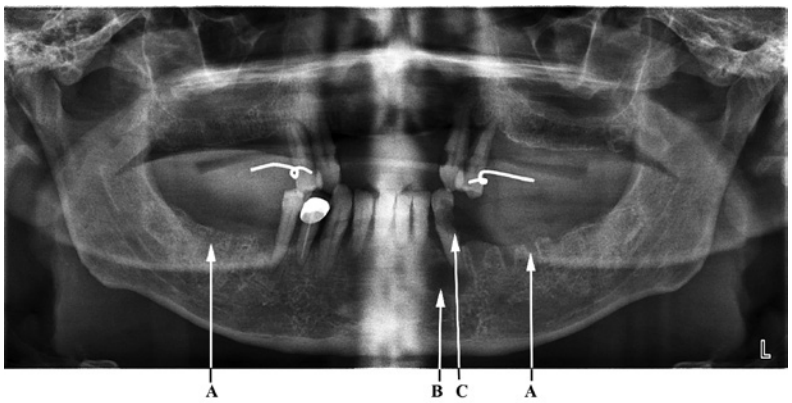

Fig 1. Dental panoramic radiograph showed dentigerous cyst (B) associated with tooth 33 in the left right mandible. Cavity of tooth 33 (C) which had penetrated into the root canal and was leading to the cyst. Tooth extracted space (A)

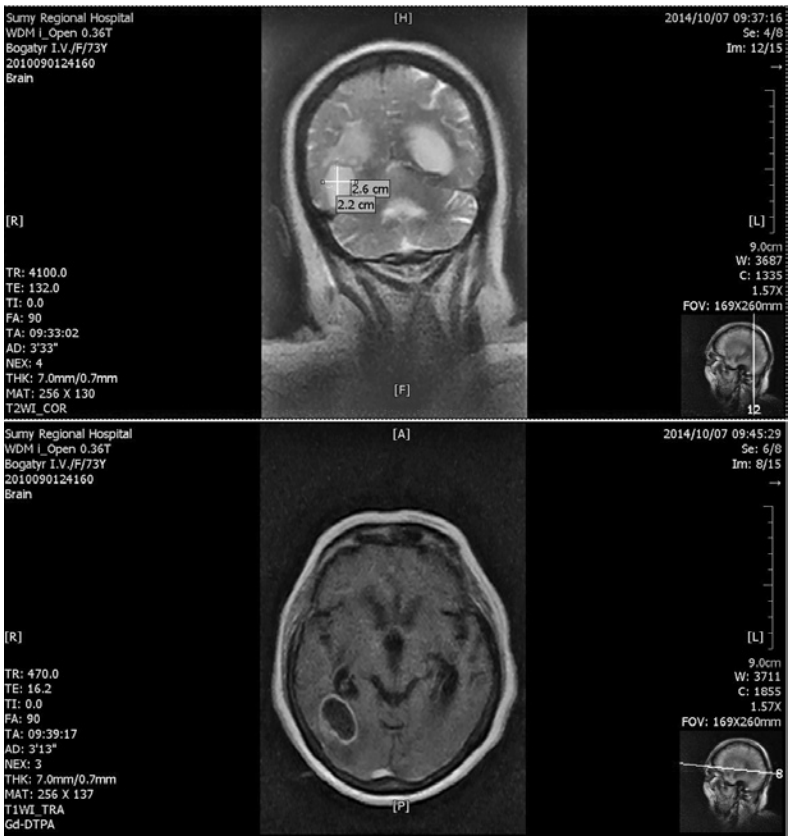

Fig. 2. Brain MRI neuro-imaging studies performed on the day when the diagnosis of abscess was made

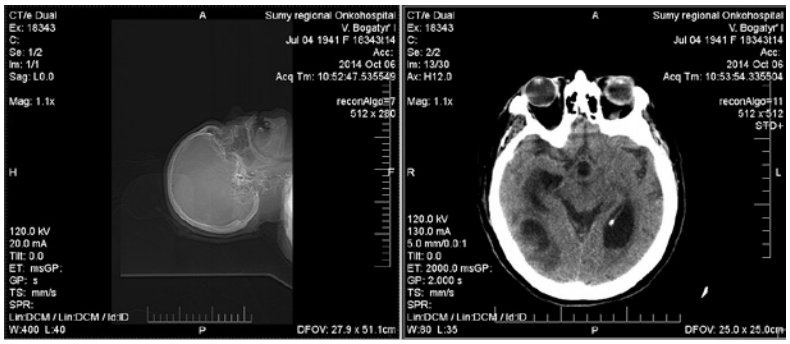

Fig. 3. Brain CT studies

Table 1. Parameters of blood

Date	Blood pressure	T – C°	White blood cells (×109)	ESR (mm/hr)	Hemo-globin g/L	Eryth-rocytes ($\times 10^{12}$)	GPT (ALAT) μkat/L	GOT (ASAT) μkat/L	Glucose mmol/L	Blood Urea Nitrogen mg/dL	Cre-atinine mg/dL
30/09/14	130/90	36.6	4.1	11	94	2.7					
31/09/14	130/90	36.6	4.1	10	94	2.7					
01/10/14	130/90	36.6	4.1	8	94	2.7					
02/10/14	130/90	36.6	4.1	10	94	2.7					
03/10/14	130/90	36.9	4.1	10	94	2.7					
04/10/14	200/120	36.6	6.35	20	94	2.7	2.4	1.7	6.4	5.9	10.7
05/10/14	200/110	36.6	17.1	32	112	3.09					
06/10/14	180/90	36.6	19.8	37	134	3.5	2.0	2.7	7.0	7.9	9.8
07/10/14	120/60	36.6	18.6	35	116	3.15					
08/10/14	120/60	36.6	19.6	35	135	3.61	2.4	4.9	4.0	11.3	13.0
09/10/14	90/40	36.6									

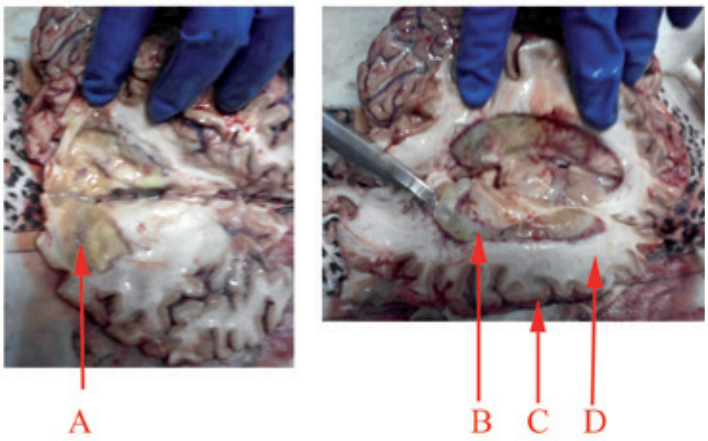

Fig. 4. Brain autopsy: A – cavity abscess, B – pus infiltration in brain ventricles, C – gray matter of the brain, D – white matter of the brain

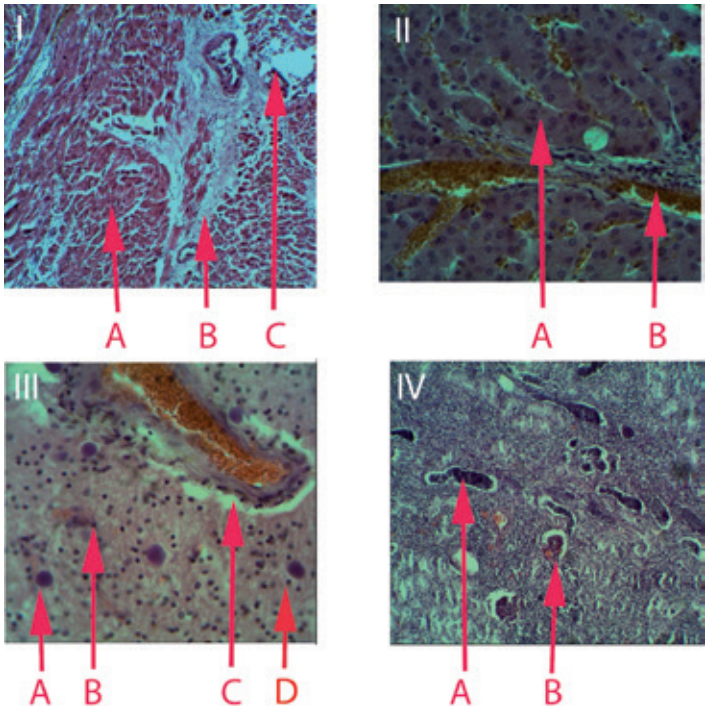

Fig. 5. Staining by hematoxylin – eosin I – myocardium zoom × 150: A – cardiac muscle cell, B – connective tissue, C – vascular edema; II – liver zoom × 400: A – hepatocytes, B – plasma cell infiltration; III – brain zoom × 400: A – microbe colony, B – zone of necrosis, C – perivascular edema, D – macrophages; IV – kidney zoom × 150: A – plasma cells infiltration, B – glomerulus

breakthrough into ventricles, and pus had spread to the spinal cord. A bacteria which caused suppuration is called pyogenic. The bacteria affected the site where they lodged, when pyaemia disseminated small septic thrombi in the blood. Odontogenic infection can lead to septic infarcts.

The brain abscess was the result of a very small microbial emboli from a cyst and a periodontal pocket. Microscopy (Fig. 5-III) of the pyogenic abscess shows a central zone of necrosis containing numerous bacteria, surrounded by a zone of suppuration and an outer zone of acute inflammatory cells. The pus was creamy. It was composed of numerous dead as well as living neutrophils, some red cells, fragments of tissue debris and fibrin. Macrophages and cholesterol crystals were not present, which indicated an acute process. In Fig. 5 II–IV, there are small microbial emboli in the kidney, liver and brain. The myocardium (Fig. 4-I) is increased in collagenous connective tissue and decreased vascularity and has fewer plasma cells.

The dental abscess was a localized collection of pus in nearby tooth structures (Fig. 6). A biopsy was performing in the mandible bone. Pieces of bony tissue were shaving using a chisel. The tissues were submitting for histopathological examination, which revealed irregular islands of bony trabeculae with evidence of osteoblastic lining. The marrow spaces showed foci of lymphocytes and plasma cells. The histopathological examination was suggestive of subacute osteomyelitis and periostitis.

The septic infarcts of the lungs resulted from the lodging of larger fragments of septic thrombi in the arteries with relatively larger foci of necrosis, suppuration and acute inflammation.

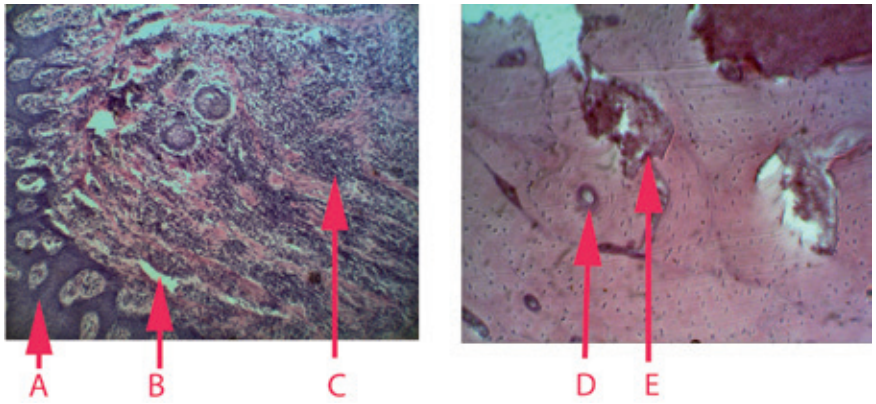

Fig. 6. Staining by hematoxylin – eosin myocardium zoom × 150: A – gingival epithelium, B – vascular edema, C – plasma cells infiltration, D – osteon, E – osteomyelitic resorption

Discussion

In the same old theme, excavations from a 7,000-year-old mortuary site in the Lake Baikal region of Siberia, in the Russian Federation, revealed an infant with osteomyelitis of the mandible [7]. Dental pathology caused death. It is rare, but it was, is and will be as rare as possible. We need to make it as rare as possible.

Chronic bronchial asthma can lead to immunosuppression. The levels of segment cells, lymphocytes and monocytes may limit the magnitude of effector responses, which may result in failure to adequately control infection [8]. Normal levels of CD4+ regulatory T cells are critical for the maintenance of immunological homeostasis and the prevention of autoimmune diseases. The mechanisms responsible for the immunosuppression associated with sepsis or some chronic blood infections remain poorly understood. Systemic exposure to bacterial or viral Toll-like receptor ligands inhibited cross-priming. Reduced cross-priming is a consequence of down regulation of cross-presentation by activated dendritic cells due to systemic activation that did not otherwise globally inhibit T cell proliferation [9]. The evolution of brain abscess in immunosuppressed patients could be divided into three stages based on histological evaluation: cerebritis stage (1 to 11 days), early-capsule stage (12 to 17 days), and late-capsule stage (18 days and later). Histologically, abscesses in immunosuppressed patients were characterized by a decrease and delay in collagen formation, a reduction in polymorphonuclear leukocytes and macrophages, longer persistence of bacterial organisms, and an increase in gliosis [10].

The most common symptoms of brain abscess are caused by a combination of increased intracranial pressure due to a space-occupying lesion (headache, vomiting, confusion, coma), infection (fever, fatigue, etc.) and focal neurologic brain tissue damage (hemiparesis, aphasia, etc.). The most frequently presenting symptoms are headache, drowsiness, confusion, seizures, hemiparesis and speech difficulties together with fever with a rapidly progressive course. The symptoms and findings depend largely on the specific location of the abscess in the brain. An abscess in the cerebellum, for instance, may cause additional complaints as a result of brain stem compression and hydrocephalus. Neurological examination may reveal a stiff neck in occasional cases (erroneously suggesting meningitis) [11]. The commonest forms of odontogenic infection are osteomyelitis. Odontogenic infection brain abscess is extremely rare [12]. In a review of world literature by PubMed, only 23 published cases were found. Dental infections have occasionally been reported as the source of bacteria, which can give rise to such a cerebral abscess [13]. An intact brain is resistant to infection. However, disruption of the blood-brain barrier caused by odontogenic infection and immunosuppression may predispose the affected brain tissue to infection and thus abscess formation. Advances in neurosurgical techniques and antibiotic treatment have greatly reduced the mortality of brain abscess to as low as 4% to 9.7% [11, 14].

In patients with brain abscess, the appropriateness of antimicrobial treatment was no different from the remaining patients, but the prognosis was extremely poor if the treatment was inappropriate. Gram-negative bacilli were more likely to be the responsible pathogens. The choice of final antibiotics was guided by the final culture results. Lu et al. [15] had cured 12 patients of brain abscesses, and they received repeated aspiration and total excision of brain abscesses. Treatment of brain abscess requires a combination of antimicrobials, surgical intervention, and eradication of the primary infection. In Taiwan, initial empirical antibiotics with third-generation cephalosporins in combination with metronidazole, should be considered for the majority of abscesses cases resulting from infection with Gram-negative bacilli and streptococcal species. Despite the availability of new antibiotics and the development of

better neurosurgical techniques, the therapeutic outcomes of brain abscess have not shown a statistically significant change, and only the presence of septic shock is a prognostic factor [15].

The odontogenic infection and immunosuppression in our patient had disrupted the brain barrier underlying the brain abscess. Knowledge of the possible risk of transfer of oral cavity infections into a brain abscess without any identified focus of infection may lead to better management of vigilance of doctors and dentists. To avoid such a fatal resolution in the future, doctors and dentists should suspect in such cases that something is going terribly wrong, using the famous triad of fever, headache and focal neurologic findings, which are highly suggestive of brain abscess.

Cerebral abscess linked to an odontogenic infection is a rare occurrence since in most individuals the blood-brain barrier along with the immune response will keep bacteria out. Odontogenic infections in the pathogenesis of a cerebral abscess is a result of immunosuppression and somatic pathology. Management of these life-threatening infections depends on the location and the dimensions of the lesion, as well as on the level of medical alertness.

Acknowledgment. We thank Zolotarova Vira, who provided the laboratory for histological studies on behalf of the group of authors. We thank Mykola Lyndin who provided counsel.

References

[1] Moorthy R.K., Rajshekhar V.: Management of brain abscess: An overview. Neurosurg. Focus, 2008, 24, 3–9.
[2] Alvis Miranda H., Castellar-Leones S.M., Elzain M.A., Moscote-Salazar L.R.: Brain abscess: current management. J. Neurosci. Rural Pract. 2013, 4, 67–81.
[3] Andrea L., Waters-Rist C.: A unique case of mandibular osteomyelitis arising from tooth germ infection in a 7,000-year-old infant from Siberia. Dent. Anthtopol. 2012, 25, 15–25.
[4] Abrar A., Wani M.Ch., Altaf U., Ramzan M.Ch., Nayil K., Malik M.Ch., Ashish Kumar M.S., Anil Dhar M.S., Furqan A., Nizami M.S., Sarabjit S., Chibber M.Ch., Wani M.Ch.: Brain abscess complicating hemorrhagic contusion in a case of closed head injury: Case report. Indian J. Neurotraum. 2011, 8, 49–50.
[5] Ezzo P.J., Cutler C.W.: Microorganisms as risk indicators for periodontal disease. Periodontol. 2000, 2003, 32, 24–35.
[6] Mylonas I., Tzerbos H., Mihalaki M., Rologis D., Boutsikakis I.: Case report cerebral abscess of odontogenic origin. J. Cranio-Maxillofac Surg. 2007, 35, 63–67.
[7] Sung Yong P., Dong Won S., Chul Min P., Min Seok O., Dong-Kun L.: Brain abscess due to odontogenic infection: a case report. J. Korean Assoc. Oral Maxillofac. Surg. 2014,40,147–151.
[8] Lypez-Phriz R., Aguilar L. Gimйnez M.J.: Management of odontogenic infection of pulpal and periodontal origin. Med. Oral Patol. Oral Cir. Bucal. 2007, 12, 154–163.
[9] Wilson N.S., Behrens G.M., Lundie R.J.: Systemic activation of dendritic cells by Toll-like receptor ligands or malaria infection impairs cross-presentation and antiviral immunity. Nature Immunol. 2006, **7**, 165–172.
[10] William G., Obana B.S., Richard H.: Experimental brain abscess development in the chronically immunosuppressed host computerized tomographic and neuropathological correlations. J. Neurosurg. 1986, 65, 382–391.
[11] Belkaid Y., Rouse B.T.: Natural regulatory T cells in infectious disease. Nature Immunol. 2005, 6, 353–360.
[12] Schuman N.J., Turner J.E.: Brain abscess and dentistry: a review of the literature. Quintess. Int. 1994, 25, 411–413.
[13] Yang S.Y., Zhao C.S.: Review of 140 patients with brain abscess. Surg. Neurol. 1993, 39, 290–296.
[14] Juárez Escalona I., Díaz Carandell A., Aboul-Hons Centenero S., Monner Diéguez A., Marí Roig A., Arranz Obispo C.: Lemierre Syndrome associated with dental infections. Report of one case and review of the literature. Med. Oral Patol. Oral Cir. Bucal. 2007, 12, 394–400.
[15] Lu C-H., Chang W-N., Lin Y-C.: Bacterial brain abscess: microbiological features, epidemiological trends and therapeutic outcomes. Q J Med. 2002, 95, 501–509.

Address for correspondence:

Yevhen Viktorovich Kuzenko
Department of Pathology
Medical Institute of Sumy State University
Sumy
Ukraine
E-mail: kuzenko_yevhen@rmbler.ru

Conflict of interest: None declared

Received: 6.11.2014
Revised: 28.01.2015
Accepted: 4.02.2015