A CASE OF SUCCESSFUL TREATMENT OF POST-TRAUMATIC FRONTAL LOBE BRAIN ABSCESS IN PATIENT DURING SUBACUTE PERIOD OF PENETRATING CRANIOCEREBRAL TRAUMA

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ABSTRACT

Brain abscesses are dangerous complications of penetrating traumatic brain injury, where the mortality rate of inflammatory processes progression is up to 60%. Risk factors for this pathology are penetrating traumatic brain injury, purulent inflammation of the lungs, bacterial endocarditis, arteriovenous fistula in the pulmonary circulation.

Brain abscesses as a result of gunshot craniocerebral traumas during military actions in World War II were developed in 7.5-27.6% cases, 84% of which were single abscesses, whereas in 16% - multiple, while during military actions in Chechnya and Afghanistan brain abscesses range decreased up to 7.5%, and during peace in case of weapon injuries up to 5%. Firstly such decreasing tendency can be explained with the improved quality of preliminary surgical debridement, secondly with the appearance of antibiotics’ new generation and thirdly, with the improvement of drainage systems incorporated onto the wounds. Brain abscesses pathogens are streptococci and staphylococci in 33-50% of cases. In 80% of cases several microorganisms are identified including anaerobic forms.

Despite the fact that traumatic brain abscess is a subject to a surgical treatment according to the classic rules, there are reports of successful conservative treatment in literature. The indications for conservative therapy are hard-to-reach location, multiple lesions less than 2.5 cm in diameter, associated meningitis, encephalitic stage of the brain abscesses. There are not so many supporters of conservative treatment. According to several authors, solely conservative treatment of the brain abscesses is not effective at all, or, if applied in the later stages, the formation of brain abscesses ends with persistent neurological deficit in more than a half of the patients.

The article presents literature review about epidemiology, pathophysiology, diagnostics and the treatment of patients with brain abscesses, as well as a clinical case of successful treatment of post-traumatic abscess of the left frontal lobe of the patient in the subacute stage of open penetrating traumatic brain injury. This case is interesting in its dynamics. Encapsulated abscess was formed in the result of inefficient conservative therapy within 1 month after traumatic brain injury.

KEYWORDS: purulent-inflammatory diseases, central nervous system, brain abscess, treatment.

INTRODUCTION

Brain abscess is defined as a nidal empyesis which mainly has a circular shape and is localized in medul-
most complete one, per some authors, is the following [Nikiforov A et al., 2004]:

- by mechanism abscesses are classified as hematogenous, traumatic, otoryhynogenic and iatrogenic;
- by localization: frontal, parietal, temporal or occipital lobes, or in cerebellum;
- by the membranes and medullary substance: epidural, subdural, intracerebral and periventricular;
- by types: single-chamber, dual chamber and multi-chamber;
- by volumes: small - up to 20 ml, middle - 21-40 ml, large - 41-60 ml, extra-large/giant - more than 60 ml;
- by clinical phase: compensation, subcompensation, moderate decompensation, savage decompensation, terminal phase;
- by flow pace: acute, subacute, chronic.

In addition, abscesses are classified as single and multiple. Some authors identify early abscesses evolved during the first 3 months and late abscesses [Lebedev V, Khutornoi N, 2008].

**Etiopathogenesis:** Risk factors for this pathology are penetrating traumatic brain injury, purulent inflammation of the lungs, bacterial endocarditis, arteriovenous fistula in the pulmonary circulation [Nikiforov A et al., 2004]. Concurrently, brain abscesses can be caused by [Lebedev V, Khutornoi N, 2008]:

- poor primary surgical debridement in the form of not removed foreign bodies, especially small bone fragments;
- untimely diagnosed and treated cerebrospinal fluid fistula;
- incompletely deleted traumatic intracranial hematoma;
- foreign body left in the wound (gauze sponges, etc.) or implanted with foreign bodies for therapeutic purposes in case of non-sterility.

The ways of pathogens spread in case of brain abscesses are contacting and hematogenous. The first one is more typical for patients with penetrating brain injury [Nikiforov A et al., 2004].

Brain abscesses as a result of gunshot craniocebral traumas during military actions in World War II were developed in 7.5-27.6% cases, 84% of which were single abscesses, whereas in 16% - multiple, while during military actions in Chechnya and Afghanistan brain abscesses range decreased up to 7.5%, and during peace in case of weapon injuries up to 5% [Shahinyan G et al., 1997; Lebedev V, Krylov V, 2000; Lebedev V, Khutornoi N, 2008]. Firstly such decreasing tendency can be explained with the improvement of preliminary surgical debridement quality, secondly, with the appearance of new generation antibiotics, and thirdly, with the improvement of drainage systems incorporating onto the wounds.

Brain abscesses belong to the complications of traumatic brain injury and among such patients with single abscesses lethality is from 5 to 22%, with multiple abscesses - from 23 to 78%, with an open traumatic brain injury - from 40 to 60% [Lebedev V, Khutornoi N, 2008].

Streptococci and staphylococci are the infectious agents in brain abscesses in 33-50% of cases. In 80% of cases several microorganisms are identified including anaerobic forms [Nikiforov A et al., 2004]. There are 3 stages of brain abscess development: latent, clear (clear signs of the abscess formation) and terminal (edema and dislocation of the brain) [Kubrakov K et al., 2006].

Initially, the brain tissue develops encephalitis that occurs based on vasculitis with the septic thrombosis and all this leads to local ischemia and, consequently, to the formation of the focus of septic necrosis [Lebedev V, Khutornoi N, 2008]. Within 2 weeks or more a capsule is appearing around this area which has 4 layers: internal (necrotic granulation), external (encephalitic, reactive) in the form of perifocal encephalitis, medium formed of connective tissue fibers, regenerative layer (organization and encapsulation) - contains blood vessels, argyrophilic and collagen fibers. From the encephalitic and regenerative layers through metastatic (hematogenous) way, subsidiary abscesses can occur at a distance from the primary focus [Lebedev V, Khutornoi N, 2008].

**Clinical description and diagnosis**

The clinical picture of brain abscess includes cerebral, meningeal, focal, hypertensive and disloc-
symptoms, the severity of which depends on the stage and timing of development. Epileptic seizures development is not uncommon - the risk of their development is about 54-76%. In some typical cases brain abscesses are accompanied by changes in the peripheral blood – leukocytosis with the left shift, accelerated ESR, increased C-reactive protein [Nikiforov A et al., 2004]. There might be no changes in blood in cases of a thick-walled capsule.

Cerebrospinal fluid changes are noted in 90% of cases, however, they are also not specific [Nikiforov A et al., 2004]. For example, when brain abscess is in depth, the composition of cerebrospinal fluid may considerably vary – in some cases there might be a moderate cell count (usually neutrophil), in others – hyperalbuminosis, in some cases - normal compositions [Kubrakov K et al., 2006]. It should be noted here that the suspected brain abscess is a relative contraindication to lumbar puncture due to the risk of tentorial herniation syndrome.

Another important symptom is the presence of stagnation in the ocular fundus, reaching in one third of the patients the degree of severe edema, and in the other one third - the initial swelling of the optic nerve. In the presence of this symptom, other signs of increased intracranial pressure are also identified: headache, vomiting, bradycardia, arterial hypertension [Nikiforov A et al., 2004].

Usage of highly informative noninvasive methods such as computed tomography (CT) and magnetic resonance imaging (MRI) undoubtedly improved the diagnostics of brain abscesses. These methods allow to define the localization of the focus, its size and shape, depth, and also to follow the dynamics of treatment [Vereshchagin N et al., 1986; Lebedev V, Krylov V, 2000; Okami N et al., 2000]. On the brain CT abscesses are identified as a form of low-density formations often oval-shaped with a circular shadow on the periphery – “crown effect”. With the contrast medium infusion, it is primarily deposited in the capsule due to its hyper vascularization [Kubrakov K et al., 2006]. Resolution of MRI is higher than CT which helps with the identification of clear visualization of secondary changes in brain (edema, deformation and displacement of the cisterns). Features of MRI may be significantly increased by using gadolinium contrast. The contrast selectively accumulates in the capsule of brain abscesses [Sufianov A et al., 2000; Nikiforov A et al., 2004]. Cerebral angiography plays a supporting role in differential diagnosis of a brain tumor [Lebedev V, Khutornoi N, 2008].

**Treatment**

Among the surgical methods for brain abscess treatment the following ones should be underlined: puncture, radical abscess removal within the capsule without preliminary biopsy, puncture followed by the removal of the capsule (combined method), opening of the abscess and external drainage. Before the use of antibiotics and sulfonamides the postoperative mortality in brain abscess was 75-100%. The use of those drugs decreased the mortality by 3-4 times [Kubrakov K et al., 2006]. Recently the method of puncture is preferable as the least invasive method in consequence of which postoperative mortality decreased to 4.7% [Mehdi A, Smayanovich A, 1996; Sufianov A et al., 2000]. Nevertheless, preservation of the abscess capsule leads to a risk of substitute abscess formation in the other areas of the brain through the hematogenous way [Lebedev V, Khutornoi N, 2008].

Despite the fact that brain abscess is a subject for a surgical treatment according to the classic rules, there are reports of successful conservative treatment in the literature [Blagoveshenskiy S et al., 2002; Kubrakov K, Protas R, 2005]. The indications for conservative therapy are hard-to-reach location, multiple lesions less than 2.5 cm in diameter, associated meningitis, encephalitic stage of brain abscess [Morgan H et al., 1973; Kubrakov K, Protas R, 2005; Lebedev V, Khutornoi N, 2008]. There are not so many supporters of conservative treatment. According to several authors, solely conservative treatment of brain abscess is not effective at all, or, if applied in the later stages, the formation of brain abscesses ends with persistent neurological deficit in more than a half of the patients [Lebedev V, Khutornoi N, 2008].

The article presents a clinical case of the classical encapsulated brain abscess formation appeared on the background of conservative treatment after a month of severe penetrating open injury.
**Clinical case description**

A 55 years old patient was brought to the Neurosurgery Department of the “Road Clinical Hospital at Irkutsk-Passenger station” of the OJSC «Russian Railways» from the Department of Neurology on 04.16.15 in critical condition with a diagnosis of “Subacute posttraumatic intracerebral monolocular abscess of brain’s left frontal lobe in the early period, the stage of subcompensation. Subacute period of severe penetrating craniocerebral open injury. Moderate brain contusion injury with the formation of foci of the 3\textsuperscript{rd} type in the right parietal lobe and the basal parts of the left frontal lobe”.

From anamnesis: Domestic injury from 03.03.15, he got a blow on the head with a shovel, and then he lost consciousness. He was hospitalized in the surgical department in the regional hospital from 03.03.15 to 22.03.15 with the diagnosis of traumatic brain injury. Brain contusion of moderate degree. Indented multisplintered fracture of the parietal bone on the right. Substance of the brain is crushed to the right parietal lobe. Multiple skin wounds in the right parietal region.

The patient was operated on 04.03.15: resection craniotomy in the right parietal region, removal of the fracture of the parietal bone. Removal of the contusion lesion in the right of the parietal lobe. Multiple skin wounds in the right parietal region.

The patient was operated on 04.03.15: resection craniotomy in the right parietal region, removal of the fracture of the parietal bone. Removal of the contusion lesion in the right of the parietal lobe. MRI of the brain from 12.03.15 showed calvaria defect in the right parietal bone, injury foci in the right parietal, left frontal lobe brain abscess, there is no displacement of median structures.

CT of the brain from 13.03.15 showed defect of the cranial vault in the right parietal bone. Injury foci of the 2\textsuperscript{nd} type in the right parietal region, and the injury focus of 3\textsuperscript{rd} type in the left basal frontal lobe with the zone of hemorrhage of 2x2x4 cm. There is no displacement of median structures.

Ophthalmologist consult was on 13.03.15: partial swelling of the optic nerve on the left.

The post-operative period was favorable, the wound healed by the first intention. Infusion, nootropic, antibiotic (cefotaxime 1000 mg, x 3 r/d/m for 7 days), symptomatic, vasoactive and restorative therapy were conducting.

The stitches were removed from the surgical wound on 20.03.15, the edges diverged on 21.03.15, a sero-purulent discharge from the fascia had started. Sanation and revision of subgaleal space was performed. No cerebrospinal fluid found. Examining surgeon diagnosed postoperative wound inflammation. Inoculation of wound discharge found fecal streptococcus of 10\textsuperscript{7} CFU.

The patient was transferred to the department of purulent surgery of “Road Clinical Hospital at Irkutsk-Passenger station” where he was on in-patient treatment from 27.03.15 to 13.04.15. The patient was conscious, responding to simple questions, sitting, eating himself, standing with assistance. CT control of the brain from 03.04.15 showed positive dynamics, reducing of the bleeding area in the frontal lobe, no signs of dislocation of the median structures, no compression of ambient cisterns. He received antibiotic treatment within 8 days: tavanic (500 mg x 2 a day/drip) and sulperasone (2000 mg, x 2 a day/drip).

Patient was discharged for rehabilitation to the Neurology Department of “Road Clinical Hospital at Irkutsk-Passenger station” on 13.04.15. The level of moderate stupefaction sensorium was marked in the general condition on 16.04.15: moderate decrease of the consciousness and rejection of the meal.

MRI of the brain from 04/16/15 revealed brain abscess in the left frontal lobe and median structures dislocation 10 mm off the midline from left to right (Fig. 1 a,b).

The patient was transferred to the Neurosurgical Center of the “Road Clinical Hospital at Irkutsk-Passenger station”. Neurological status: the overall condition is grave, moderate level of consciousness decrease. He is available for limited productive verbal contact - answers to simple questions, performs basic commands.

According to the neurosurgical consultation on 16.04.15, the patient was operated: resection craniotomy was performed in the left fronto-temporal region. Left frontal lobe brain abscess was punctured. Sanitation of abscess cavity, subtotal removal of abscess capsule and drainage of the abscess cavity.

The operation: under intravenous anesthesia with mechanical lung ventilation after cleaning of the surgical field with antiseptic solutions and pre hydro-preparation of soft tissues with saline, a
A horseshoe-shaped incision of the skin was produced in the left fronto-temporal region. Soft tissue flap was retracted downward and fixed. The periosteum was dissected. Bone was cleaned from debris. A burr hole was made in the frontal region, followed by an extension to the size of 5.0 × 6.0 cm. After removing of the bone flap the dura mater appeared to be pale, without pulsation and was strained. The dura mater was opened in arch fashion. There was a mild bulging of the brain, and Mannitol was administered (Fig. 2 a,b). Hemodynamics was stable, pulsation of the brain was sluggish.

Under the ultrasonic navigation ALOCA 500 (Hitachi, Japan) the abscess of the left frontal lobe was localized, and a puncture cannula was inserted to drain the abscess (Fig. 3). 40.0 ml of pus mixed with hemolyzed blood were evacuated via syringe. The content of the abscess was taken for the inoculation on microflora and sensitivity to antibiotics. The abscess cavity was washed with the 0.05% chlorhexidine.

The capsule of the abscess was thick, well separated from the brain tissue. Microsurgical dissec-
tion of the capsule from the surrounding brain tissue and subtotal removal was performed. Dorsomedial segments of the capsule was partially saved and firmly attached to the skull base (Fig. 4 a,b).

The wound was washed with antiseptic solutions. Double-lumen drainage equipped with the irrigation system was installed in the left temporal region of abscess cavity through the counterpuncture [Sufianov A et al., 1999] (Fig. 5). The dura mater was sutured with separate sutures. Wound was closed in layers with the installation of drainage under the fascia and aseptic dressing. The estimated total blood loss was less than 300 ml.

Histological examination of the removed material confirmed the diagnosis of brain abscess with the formation of connective-tissue capsule (Fig. 6 a,b).

Description of the microslide: the wall of the abscess has a layered structure, is shown inside of overlapping necrotic tissues with neutrophilic infiltration, followed by a layer of granulation (a large number of newly formed blood vessels, full-blooded, mainly capillary type, anastomosing with each other and arranged in different directions). Thin gray argyrophilic fibers and loops which contain numerous cells infiltrates: neutrophils, lymphocytes, macrophages laden lipid inclusions are located around vessels. There is a thin connective tissue capsule from outside, with the gentle network of collagen fibers and fibroblasts.

The patient was receiving symptomatic, antineuritic, antiedematous, anticramping and antibacterial (meronem 1000 mg x 3 a day/drip, amikacin 500 mg x 2 a day/m for 8 days) therapy in post-operative period. The drainage was removed on the 8th day after surgery. Postoperative changes are shown on MRI of the patient (Fig. 7 a,b). The patient was discharged on the 14th day in a satisfactory condition with partial regression of neurological symptoms. He was stable on the subsequent follow-up examination 3 months after surgery and had no complaints.

**DISCUSSION**

Over the past decade, our understanding of the etiology, clinical presentation, diagnosis and treatment of brain abscess underwent subsequent evolutionary changes [Mehdi A, Smeyanovich A, 1996;
Shahinyan G et al., 1997]. In the last century, up to 2/3 of brain abscess had otorhinogenic etiology, but today metastatic brain abscesses compose up to 34.3%, while the contact (mainly otorhinogenic) - 29.4%, traumatic - 27.5%, cryptogenic - 8.8% [Vereshchagin N et al., 1986; Protas R, 2000; Protas R, Vyhristenko S, 2002]. These changes occurred due to the achievements in otolaryngology, and due to steady growth of neuro-traumatism [Kubrakov K et al., 2006; Morgan H et al., 1973]. According to various authors, the percent of post-traumatic brain abscess is more than 30% [Mehdi A, Smeyanovich A, 1996].

The modern diagnostic CT and MRI scans play important and sometimes decisive role in the diagnosis of brain abscess, because clinical detection of brain abscess formation on the background of severe head injury or multiple organ somatic pathology is not always possible [Sufianov A et al., 2000; Kubrakov K et al., 2006]. There are number of cases when patient’s condition remains satisfactory for a long time after the traumatic brain injury, and then suddenly worsens, which usually corresponds with a break of an abscess into the subarachnoid space or ventricular system [Kubrakov K et al., 2006]. The accurate localization of lesion allows choosing the most appropriate approach for surgical evacuation.

**Figure 6.** Morphological image of brain abscess with the formation of connective-tissue capsule under X 40 magnification: a) staining of hematoxylin-eosin, b) staining of picrofuchsin.

**Figure 7.** Postoperative changes on MRI of the 55 years old patient F.: a) T1 WI sagittal section; b) T2 WI frontal section
Brain abscess result in mortality in 0 to 10% of cases may lead to disability in up to 45% of cases, and has potential for the new seizures in 27% of cases. For comparison, before the antibiotics and sulfonamides, mortality rate was 100% [Nikiforov A et al., 2004; Kubrakov K et al., 2006]. Some authors were able to obtain favorable outcomes with the puncture treatment and decrease mortality to 4.7% [Mehdi A, Smeyanovich A, 1996; Nikiforov A et al., 2004].

It should be noted that the desire to sustain awaiting tactics hoping for a total isolation of brain abscess by the formation of the capsule is quite natural, however, this approach may lead to the development and progression of the meningoencephalitis or to the spread of infection to the bones of the skull, septicopyemia and formation of purulent subsidiary foci [Sufianov A et al., 2000; Lebedev V, Khutornoi N, 2008]. Therefore, during the conservative therapy, it is necessary to conduct a strict dynamic body temperature control (special attention should be paid to possible hectic nature), blood analysis (leukocytosis, erythrocytes, hemoglobin, hematocrit), liquor (cell count, protein, crops data), as well as the instrumental data (ultrasound, CT, MRI). Surgical intervention is required in case of the slightest signs of generalization – increase of purulent encephalitic focus, reduction in the defense reactions (e.g., reduction of leukocytosis against the backdrop of growing encephalitic focus) [Lebedev V, Khutornoi N, 2008].

The successful treatment of brain abscess with the high-energy carbon dioxide laser is reported. The positive effect of this treatment was observed in 88.4% of patients, and the mortality was 11.5% (against the current mortality rate from a single abscess from 5 to 22%, and multiple - from 23 to 78%) [Matveev S et al., 1995].

In this way brain abscesses still represent a severe complication of penetrating traumatic brain injuries with a significant risk of adverse outcome. Active surgical tactics, along with adequate antibiotic therapy based on the culture sensitivity is a priority approach for brain abscess treatment. Removal of brain abscess in the subacute period of open penetrating craniocerebral injury with the subtotal excision of the capsule and draining of the abscess cavity allows successful localization of the inflammatory process and prevention of the postoperative complications.

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REFERENCES


