

Actual interdisciplinary management of the septic intracranial neurosurgical lesions

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ABSTRACT

Brain abscesses still represent a major challenge for neurosurgical practice. The proper management of the abscess and of its generating condition has been a matter of discussion for decades. In order to achieve total cure with minimal neurological sequels modern neuroimaging, stereotactic techniques and up-to-date antibiotic treatment are mandatory.

The authors present their experience in a consecutive series of 7 patients (between January 2004 and March 2006) in which the general outcome has proven to be extremely satisfactory.

Abbreviation list

CT – computed tomography

CSF – cerebro-spinal fluid

MRI – magnetic resonance imaging

The septic intracranial lesions have represented a major issue for the neurosurgical practice since the early years of this medical specialty. Though their incidence has steadily decreased over the years, their proper and effective management still requires a correct diagnosis and an exquisite neurosurgical technique. Classically there has been described a higher incidence in developing countries (1). The general access to modern antibiotics being

improved all over the world, the incidence of the septic neurosurgical lesions has dropped to an average of less than 1% of all intracranial expansive processes. Another general trend of the evolution of these diseases is, in both developed and developing countries, the occurrence of more pathogenic and sometimes poliresistent bacterial strains.

The already described major seeding pathways into the central nervous system are still found in the actual pathology: direct

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inoculation (mainly in open head and spine traumas), spreading from a contiguous infectious process (paranasal sinuses, mastoiditis a.o.), haematogenous dissemination (resulting in metastatic abscesses), cryptogenic and iatrogenic (15). Special mention has to be made for the cyanogenic congenital heart diseases (e.g. Fallot tetralogy) and the immunodepressed patients of various causes who since their treatment is actually more effective and leading to a higher life expectancy, tend to be more subjected to the occurrence of systemic and nervous tissue septic lesions (3,8,12).

The present experience includes 7 patients treated for intracranial septic collections between January 2004 and March 2006. This study represents a new modality of management of these lesions, different from the classical one, by the fact that the targeting of the lesions was performed by stereotactic approach (6,7).

The classical "open-sky" neurosurgical technique has several important setbacks when dealing with profoundly located brain abscesses. It breaks the complex barrier that the organism manages to establish around the septic lesion, thus opening the gate for a number of complications such as local recurrences along the pathway of the surgical approach itself, meningeal and CSF inoculation, bone-flap osteitis a.o. Of course the risk of iatrogenic new neurological deficits is also very high when using the classical neurosurgical approaches. The concept of total removal of the abscess, including here the surrounding cerebral tissue that is structurally modified into a limiting membrane is most often responsible for the occurrence of iatrogenic new deficits or various forms of epilepsy. The recent experience acquired with puncturing the deep seated cerebral abscesses has proven that, after evacuation and disappearance of the abscess itself, the limiting membrane tends to gradually disappear as well, with partial but usually with total functional recovery of these cerebral areas (13).

The age of the patients have ranged between 6 and 54 years old. In the same period in the above mentioned neurosurgical department there have been treated 1213 intracranial tumors. The septic processes of our series represents 0,57% out of the total amount of these intracranial expansive processes treated during this period.

Following the general trend observed during the last decade in all systemic infectious diseases,

which tend to have a less dramatic and sometimes even a temporary subclinic period of onset, the classic complex of symptoms and signs is less encountered. In very few cases the onset comprises high fever, leucocytosis and a severely altered general condition. In the actual series only one patient has "respected" this classic onset. This particular change in the natural history of the disease makes the diagnosis more difficult.

The neuroimagic studies are compulsory for the diagnosis (usually both CT and MRI studies being necessary). The imagistic appearance of both brain abscesses and of the subdural empiemas is not pathognomonic. The differential diagnosis for brain abscesses includes: brain gliomas, mainly glioblastomas, cerebral ischemic strokes with hemorrhagic transformation, resorbitive hemorrhagic strokes, cystic and metastatic brain tumors, brain tuberculomas (4). As for the subdural empiemas the imagistic studies may not always make the difference to the chronic subdural hematomas.

The classic neurosurgical approach of the brain abscesses is the total removal through open-sky surgical procedures. Later, mainly for the patients in poor general condition, there has been imagined a less invasive, burr-hole puncture/aspiration/antibiotic instillation procedure, which has proved to be more effective than expected (Figure 1).

Nowadays, a large approach is still recommended for the surgical cure of the subdural

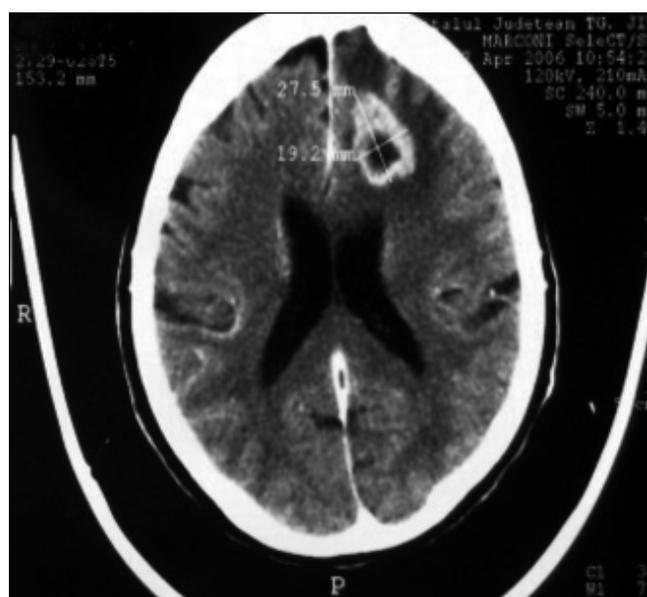


FIGURE 1a. Glioblastoma

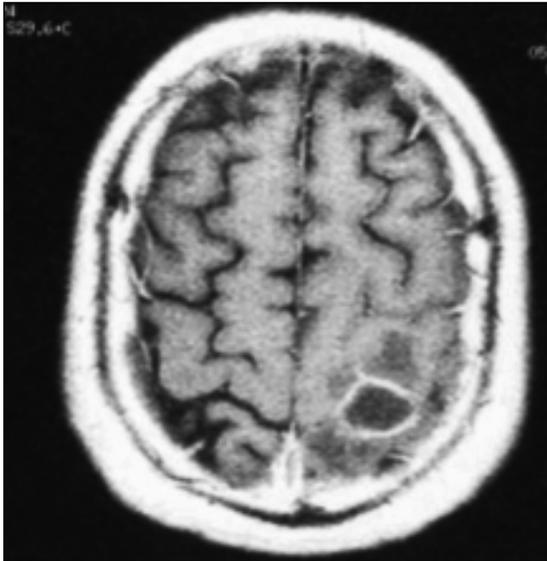


FIGURE 1b. Brain abscess. Marginal contrast enhancement and perilesional edema are present in 1a and 1b.

empiemas. Sometimes, in these cases, since the usual surgical procedure for the chronic subdural hematomas implies a double burr-hole evacuation and the existence of a septic process may be an intraoperative surprise, the surgical approach has to be modified in a larger skull opening, requiring a sufficiently large bone flap.

The advent of the stereotactic techniques has opened a new field of action for the more effective treatment of brain abscesses (2,5). With these techniques there are no more blank punctions. The stereotactic burr-hole puncture/aspiration/antibiotic instillation procedure has become the first choice in the neurosurgical approach for the profoundly located and eloquent areas brain abscesses in the IIIrd Neurosurgical Department of the “Bagdasar-Arseni” Clinic Hospital. Using this modern technology, the authors are now able to treat in a minimally invasive way multiple and/or multi-

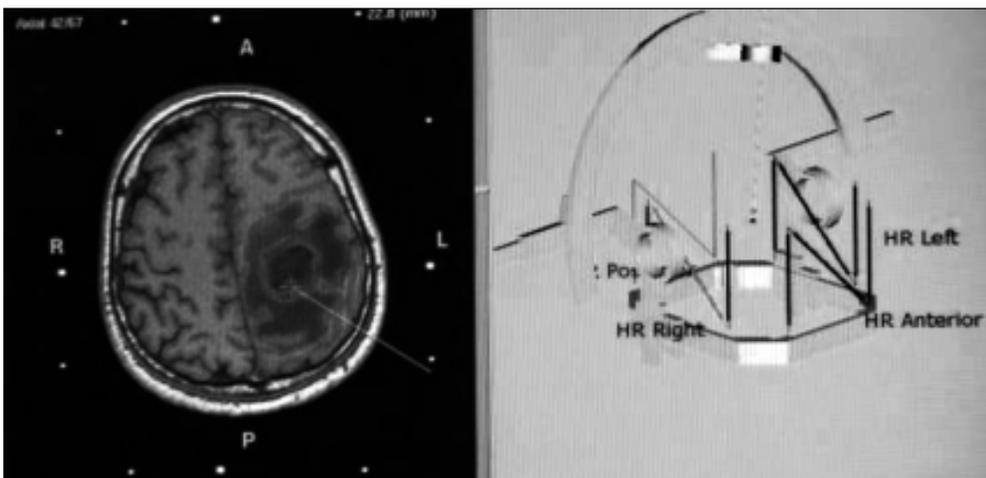


FIGURE 2. Stereotactic frame; preoperative aiming

loculated brain abscesses. The procedure also eliminates the risk of intracerebral iatrogenic inoculation since it is done with a needle (and not with a multiple-holes trocar). It also may be repeated with less surgical discomfort for the patients whenever the control imagistic studies require it (e.g. for 6 patients in the actual series bearing brain abscesses there has been performed 15 stereotactic punctions) (Figures 2,3) (9).



FIGURE 3. Preoperative aiming of multiple, multiloculated brain abscesses. The stereotactic puncture of the second lesion requires a repeated CT / MRI scan immediately after the approach of the multiloculated lesion because the “shifting process” of the cerebral mass after the first puncture will modify the stereotactic coordinates. This entire complex procedure is performed in a single session of general anesthesia.

Another major improvement in the general management of the septic intracranial lesions of our series has been the bacteriological diagnosis made in collaboration with the “Matei Balț” Infectious Diseases Institute, which is provided with one of the most up-to-date dedicated laboratory in our country. The pus obtained intraoperatively is processed in this modern laboratory, therefore the chances of identification of the infective strain(s) are enhanced. Thus, this interdisciplinary management reduces the period of time when, after surgery, the patient undergoes a large spectrum combination of antibiotics, to no more than 72 hours, and allow an earlier, since the bacterial identification is shortened, onset of the targeted antibacterial treatment. After the germ is identified, the antibiotic treatment respects the principle of de-escalation (10).

The authors would like to emphasize that for the treatment of all body infections a combination of expensive antibiotics is by far more effective than the use of cheaper products that are usually also devoid of effect (14).

In the last period, the clinical presentation of the cerebral abscesses has modified substantially, meaning that they don't have the classic background of fever, intracranial hypertension and neurological focal signs. More often than not the cerebral abscesses are discovered intraoperatively due to a previous poor specific symptomatology.

In these conditions, the antibiotic treatment has to be started without previously knowing the bacterial etiology.

A correct bacteriologic approach must respect a standard attitude of the doctor who comes in contact with a cerebral abscess. The first gesture is represented by the prelevation of bacteriological samples from the admittance in the hospital of any patient presenting fever and nonspecific inflammatory syndrome (blood, urine, pharyngeal exudates). All of these must be done preoperatively. The second step is represented by the identification of the primary septic localizations that can be the source of intracerebral insemination (sinusitis, otomastoiditis, dental infections, endocarditis and pielonefritis), imposing clinical and complex imaging explorations and interdisciplinary consults.

If the abscess was diagnosed pre- or intraoperative, the antibiotic scheme must be chosen empirically, without knowing the pathogenic

agent or his antibiotic sensibility. That's why the most frequent etiologies must be well kept in mind (which eventually may be suggested by the primary infectious places). The common germs found are: pneumococcus (with the starting point mastoiditis and sinusitis), different types of streptococcus: Viridans, Bovis, Zooepidemicus, Faecium, Fecalis etc, aerobic and anaerobic infections (with starting point in the oral cavity or endocardial cavities), staphylococcus aureus (originating in skin, lungs or endocardium), Gram negative bacilli: and enteral bacteria, especially Klebsiella, Enterobacter, Acinetobacter, ESBL highly productive and multiresistant *Pseudomonas aeruginosa*.

Being aware of these germs virulence and their potentially high resistance to antibiotics (MRSA, Enterococcus, Klebsiella, Pilocianic and in the last period *Pneumococcus*), the antibiotic scheme must achieve more objectives:

1. to create a large spectrum, applied on all mentioned etiologies;
2. to provide synergic potential of the antibiotics used in the scheme;
3. to assure a good penetrability through the blood-brain barrier to provide larger concentrations of antibiotics in the CNS than the bacterial MIC;
4. an appropriate dosage of antibiotics, according to the severity of the infection, to the weight of the patient and to the PK/PD properties of the antibiotic. This is not the proper clinical situation to make economies, especially regarding antibiotics.

These being the reasons, an initial “empiric” scheme must contain a carbapenem (imipenem-cilastatin, meropenem), an IIIrd or IVth generation cephalosporine (cefpiroma, cefepima) and a glycopeptide (vancomycin) +/- an IVth generation fluoroquinolone. When the germ and his antibiotic sensibility are identified it can proceed to a de-escalation of the antibiotic treatment depending on the antibiogram⁽¹¹⁾.

One must not omit the fungal etiology (*Candida albicans* and non-*albicans*, *Aspergillus* spp.) and if in the first 72 hours of empiric antibiotic therapy there will be no clinical or biological response, than an antifungal agent (azole or cespofungin) has to be associated.

The actual series includes 6 patients with brain abscesses (2 patients with multiple and multiloculated lesions) and 1 patient with subdural empiema. The outcome of all patients

has been extremely satisfactory from the neuro-functional point of view. All patients are now fully socio-professionally reintegrated, devoid of neurological sequels (Figure 4).

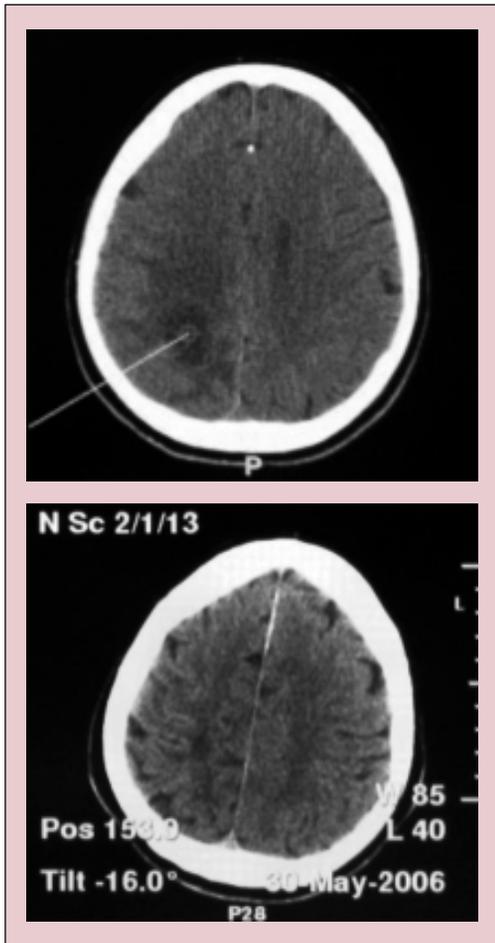


FIGURE 4. Brain abscess. Up: preoperative CT appearance. Down: postoperative and postantibiotherapy CT appearance.

The authors consider that this method of management should be applied nationwide in experienced neurosurgical and infectious diseases clinics for the best interest of the patients (Figure 5).

Concluding, the cerebral abscesses, life-threatening infections, can be treated correctly and successfully if their approach is interdisciplinary (surgeon and infectionist), this being demonstrated by the strong collaboration between the “Bagdasar-Arseni” Clinic Emergency Hospital, IIIrd Neurosurgical Department and “Matei Balș” Infectious Diseases Institute, until

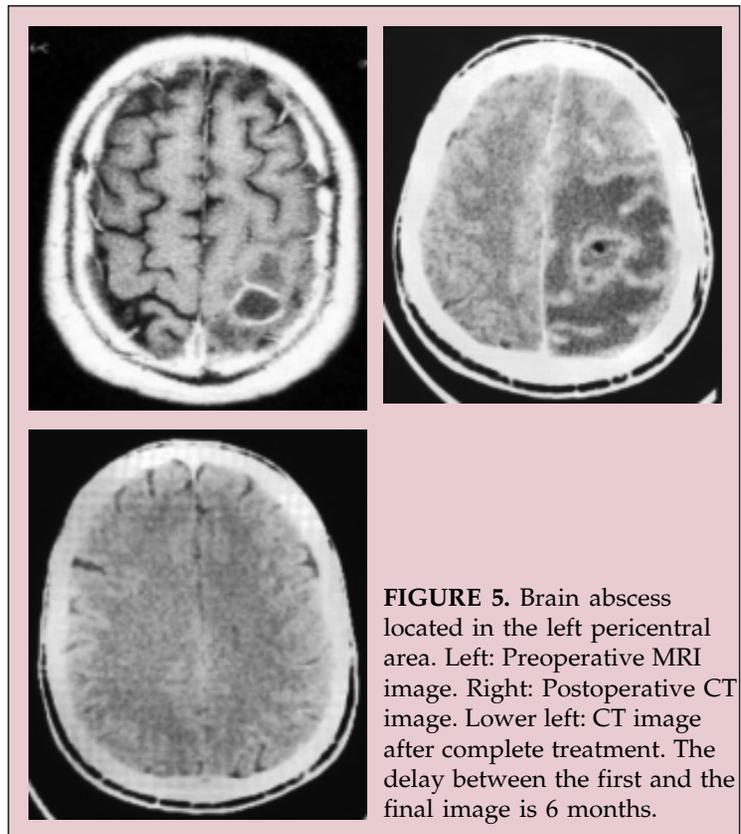


FIGURE 5. Brain abscess located in the left pericentral area. Left: Preoperative MRI image. Right: Postoperative CT image. Lower left: CT image after complete treatment. The delay between the first and the final image is 6 months.

the neurosurgical departments will have access to better equipped microbiological laboratories.

The main reason of this article, besides presenting the very satisfactory results of the authors in the actual series, is to elicit a concept of practical medical “know-how” when dealing with brain abscesses, applicable in the current conditions of the Romanian medical system and not to provide an “ex-cathedra” false novelty, since this complex management is already practiced successfully in other countries. This multidisciplinary management is in reality not so difficult to set in place as it seems and has the great advantage of providing a maximal use of the medical practical possibilities of our country at this time, all of which being done in the interest of the total cure and perfect social reinsertion of the patients.

The authors also want to stress upon the low risk of complications of the medical management method used and the decreased periods of hospitalization required for these patients. □

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