Antibiotics in Management of Intracranial Abscesses

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Abstract

Background: Brain abscess accounts for 8% of intracranial lesions in developing countries, where as in the west it accounts about 1-2%. The ideal way in management of intracranial abscesses remains a matter of controversy.

Objectives: Our aim in this study is to put an updated protocol of antibiotics for management of brain abscesses and to evaluate it regarding clinical and radiological outcome, recurrence rate, duration of antibiotic usage, and the duration of hospital stay.

Patients and Methods: This study was done over 30 patients presenting between November 2013 and June 2015 with intracranial abscesses managed either medically or surgically by aspiration through a burr hole, excision with open craniotomy, with a specific protocol of antibiotics and then followed up clinically and radiologically.

Results: There were twenty male (66.7%) and ten females (33.3%). A nearby cranial infection was the most common predisposing factor in fourteen patients (46.6%). The temporal lobe was the most common location of the abscess in our study in eleven patients (36.7%). The most common isolated organism was Methicillin-resistant Staphylococcus aureus (MRSA) in eight cases (26.7%). No growth was the result of the culture in twelve cases (40%). Four patients needed only medical management (13.3%). Six patients underwent complete excision as the primary management (20%). The remaining twenty patients underwent aspiration via a burr hole (66.6%). Twenty four patients (80%) had favorable outcome in form of complete clinical and radiological improvement. Five cases (16.6%) presented with recurrence, three were managed by surgical excision and two were managed medically with no mortalities.

Conclusion: The choice of antibiotic agents should be based on culture results when possible. In the absence of positive culture results, therapy with third-generation cephalosporins combined with metronidazole and vancomycin can be considered.

Key Words: Brain – Abscess – Infectio – Antibiotics.

Introduction

BRAIN abscesses continue to pose diagnostic and therapeutic challenges. Brain abscess accounts for about 8% of intracranial masses in developing countries, where as in the west the incidence is 1-2%. Their etiology and management remain complex and unclear, making improvement of treatments and outcome difficult [1,2].

Infection of brain parenchyma begins with an area of inflammatory changes called cerebritis. Once infection is established, the brain abscess evolves through a series of stages [3].

The clinical manifestation of fever, headache, and focal deficit is usually suggestive of brain abscess, but new studies reported that this triad occurs only in about 2%-34% of cases [4].

Therapy should be started with broad spectrum antibiotics (cross blood-brain and blood-Cerebrospinal Fluid (CSF) barriers in adequate concentrations) [5].

The mechanism by which antimicrobial drugs pass from the systemic circulation to brain parenchyma is complex; the physiological characteristics of the blood-brain barrier and the blood-CSF barrier are distinct [6].

Case series reviewing all causes of bacterial abscess report Streptococci as the most commonly isolated organisms from abscess material, blood cultures, or both [7,8].

In most series, multiple organisms were identified in 14-24% of patients with positive cultures from abscess material. No organism is identified in the abscess material in 19-42% of patients, which appears to be related to the empirical use of antibiotics before surgery [8-11].
Medical management started with a broad spectrum antimicrobial which covering: Anaerobic pathogens, such as a third-generation cephalosporin and metronidazole, plus vancomycin, according to the predisposing factors they can be used till the pus is over and the antibiotic sensitivity become available, specific antibiotic agents for the organism cultured should be used.

According to this, Arlotti et al., recommend (Grade D) that samples taken from the brain abscess must be taken without antibiotic therapy or, at least within 3 days of the start of it.

The variety of microbial agents in brain abscess and knowing that many abscesses are polymicrobial (specially the otogenic and metastatic abscesses) necessitates empirical antibiotic therapy against both aerobic and anaerobic organisms.

The duration of antibiotic therapy depends on the size of abscess, association of surgical treatment, the organism, and response to treatment. However, Arlotti et al., consider (grade C) a duration of 4-6 weeks of intravenous agents for surgically treated abscesses, and 6-8 weeks for those who treated only medically and in the case of multiple brain abscesses when larger ones are treated surgically.

Usually, “triple high dose” of intravenous antibiotics for 2 weeks then 4 weeks with oral antibiotics is recommended; and for 3-12 months for patients who are immune-compromised.

Patients and Methods

The study was done prospectively in the Neurosurgery Department, Cairo University on patients suffering from intracranial abscesses presenting starting November 2013 through June 2015.

Thirty patients with intracranial abscesses were managed either medically or surgically by a specific protocol of antibiotics and then followed-up clinically and radiologically.

A proper history was taken for all patients including age, gender, fever, history of trauma, history of infection, congenital cyanotic heart disease, diabetes mellitus, decreased immunity, previous surgery, symptoms of elevated intracranial pressure (headaches, vomiting, bulging fontanelles in children, and deteriorating consciousness), neck pain, focal neurological deficits, seizures.

All patients were examined carefully for any clinical findings like: Altered level of consciousness on GCS, papilledema, meningism, cranial nerves affection, any neurological deficit (Hemiparesis,...), ear examination (discharge, otitis media,...), nose examination (sinusitis,...), scalp examination (scalp wounds of previous trauma or surgeries).

All patients underwent CT scan with contrast and/or MRI with contrast imaging before a decision was made about the management. Routine labs were done for all patients including TLC, ESR and CRP and blood culture.

In cases were managed medically only the following drugs were used:

A- Analgesic antipyretic.
B- Anticonvulsant.
C- Steroids: Only when there is a significant mass effect, massive cerebral edema or the patient mental status is depressed.
D- Antibiotics: Start with empirical intravenous antibiotics unless there is a previous cultures available in form of:
1- Vancomycin for adults IV 15 to 20mg/kg every 8 to 12h and for pediatrics 15mg/kg every 8h slowly over one hour.
2- Third generation cephalosporin for adults IV 2g once daily (or equally divided dose every 12h), for pediatrics 50 to 75mg/kg once a day (or equally divided dose every 12h).
3- Metronidazole for adults loading dose IV 15mg/kg then maintenance dose IV 7.5mg/kg every 6h with maximum dose 4g/day, and it should be infused slowly over one hour, and for neonates IV 7.5mg/kg every 24h, and for 1 month or older age IV 22.5mg/kg/day divided in 3 doses with maximum dose 1.5g/day.
E- The duration of IV antibiotic should be 6 weeks (the duration of treatment become shorter if the abscess was surgically managed).
F- A course of 4 weeks only was sufficient for cases of cerebritis.
G- A longer course (>6 weeks) was used for cases with multilocular abscesses or immunocompromised patients.
H- The duration of therapy was adjusted also by the patient’s general condition, the organism, and response to treatment.
I- Also the duration of therapy was guided by continuous assessment of the clinical condition and radiological follow-up every week by CT or MRI with contrast (the clinical improvement may precede the radiological improvement) and...
the antimicrobial course was continued until the clinical response occurs and CT or MRI findings show resolution.

J- Follow-up liver and renal functions, ESR, CRP, CBC, and blood cultures were frequently done.

K- Changing to oral antibiotics was done after 4-6 weeks by replacing Vancomycin with Linezolid tab 600mg twice daily, and Mertonidazole by its oral form 7.5mg/kg every 6h, and Amoxicillin/clavulanic acid 1g tablets every 12h till the end of the course for another 4 weeks.

In cases managed surgically:

The broad spectrum antimicrobial therapy was continued until the results of the cultures appeared. If it was positive, the antimicrobial therapy was changed accordingly and if it was negative the broad spectrum antimicrobial therapy was continued throughout the length of the course.

The course of antimicrobial therapy after surgery was shorter than that of conservative medical cases as it continued for 4 weeks and changed to oral form after 2 weeks.

Evaluation:

Each patient was evaluated regarding:

1- Radiological evaluation: Follow-up CT brain with contrast and/or MRI brain with contrast was used to assess the progression of the cases regarding size of the lesion, surrounding edema, maturity of the lesion, development of associated pathology (hydrocephalus, subdural empyema, ....), mass effect and midline shift.

2- Clinical evaluation: Improvement of manifestation of increased intracranial pressure, conscious level on GCS, motor power, and control of seizures.

Results

There were twenty male (66.7%) and ten females (33.3%) with male to female ratio (2:1), ranging in age from 12 months to 70 years (median 32 years) at time of presentation.

Regarding the predisposing factors, fourteen patients (46.6%) had adjacent cranial infection (chronic otitis media, paranasal sinusitis, or periorbital infection), three patients (10%) had heart or lung diseases (congenital heart diseases or pneumonia), four patient (13.3%) had post traumatic abscesses, two patients (6.7%) had postoperative abscesses, and seven (23.3%) had no identifiable predisposing cause.

Seven patients (23.3%) had associated medical diseases which may predispose or aggravate the abscess formation or may help in recurrence (diabetes mellitus), one patient (3.3%) is drug abuser, and one patient (3.3%) had history of lymphoma followed by adjuvant chemotherapy.

There were three cases (10%) with multilocular abscesses, a case (3.3%) presenting with the abscess associated with hydrocephalus, and another case (3.3%) associated with subdural and extradural empyema.

Four patients only (13.3%) needed medical management with or without other associated surgical interventions (one case underwent V-P shunt and another two cases under went surgical mastoidectomy).

Six patients (20%) underwent complete excision of abscesses with craniotomy as the primary surgery.

The remaining twenty patients (66.6%) underwent aspiration via a burr hole. Seven of them only (23.3%) needed aspiration once. And ten patients (33.3%) had repeated aspiration twice (in eight cases) or three times (in two cases). Three patients of them (10%) needed surgical excision after failed repeated aspiration.

Regarding the results of the cultures the most common isolated organism was Methicillin-Resistant Staphylococcus Aureus (MRSA) in eight cases, Streptococcus pneumoniae in two cases, and one case of all of the following (E coli, Staphylococcus aureus, Streptococcus viridans, B-hemolytic streptococcus, Streptococcus milleri. No growth was the result of the culture in twelve cases. No culture was obtained in three cases that were managed medically and only one case from those who managed medically we had a culture results from the subgalial collection (Table 1).

No patients had > one organism isolated from the abscess content. The antibiotics changed to another appropriate ones according to the results of culture and sensitivity in ten patients (Table 1).

Regarding to the clinical outcome twenty four patients were completely improved. Six patients showed incomplete recovery (four patients of them had moderate residual weakness, one of them had residual visual field defect, and one had hearing deficit). One patient had postoperative complication in the form of wound infection which was managed and resolved after regular repeated dressing (Table 2).
Five patients (16.6%) presented again to us after complete radiological improvement and completion of the course of medications with recurrence. By analysis of the old data we found that three of them were diabetic, all of them were managed by surgical aspiration through a burr hole which was needed to be repeated in four of them. The results of culture were MRSA in four cases and no growth in one case. After recurrence three cases were managed by surgical excision. Two cases were managed medically. All of them improved both radiologically and clinically except one case that developed a new persistent residual weakness.

Table (1): Results of the cultures.

<table>
<thead>
<tr>
<th>Culture result</th>
<th>Number of case</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>No growth</td>
<td>12</td>
<td>40</td>
</tr>
<tr>
<td>MRSA</td>
<td>8</td>
<td>26.7</td>
</tr>
<tr>
<td>S.pnumoniae</td>
<td>2</td>
<td>6.7</td>
</tr>
<tr>
<td>E.coli</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Staph aureus</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>S.virridens</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>B hemolytic strep.</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>S.milleri</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>No culture</td>
<td>3</td>
<td>10</td>
</tr>
</tbody>
</table>

Table (2): Clinical outcome.

<table>
<thead>
<tr>
<th>Clinical outcome</th>
<th>Number of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completely improved</td>
<td>24</td>
<td>80</td>
</tr>
<tr>
<td>Incomplete recovery:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual weakness</td>
<td>4</td>
<td>13.3</td>
</tr>
<tr>
<td>Visual field defect</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Hearing deficit</td>
<td>1</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Discussion

Brain abscess still considered a neurosurgical challenge despite the presence of a newer and effective antimicrobials, radiological, and neurosurgical techniques. And it is also a challenge for the neurosurgeon because it needs good clinical and surgical skills for providing a good outcomes and prognosis [1].

In Nathoo et al., [14] series which is the largest published clinical series including 973 patients with intracranial abscesses, they found that the Otorhinogenic source of infection was the primary source in (38.5%) of patients, and the trauma was the etiology in (32.8%) of patients. Additional etiologies included pulmonary (6.8%), cryptogenic (4.6%), postsurgical (3.2%), meningitis (2.8%), cardiac (2.7%), dental (0.9%), and others (7.7%). Compared to our results we find that in our study the commonest source was also the otorhinogenic in (50%) of cases, followed by cryptogenic in (23.3%), then post traumatic in (13.3%), postoperative (6.7%), pulmonary and cardiac in (10%).

Case series reviewing all causes of bacterial abscess report Streptococci as the most commonly isolated organisms [7,8]. The most commonly identified Streptococcus(s) species were the S. milleri group including S. intermedius, S. constellatus, and S. anginosus. Staphylococcus aureus was isolated frequently, more commonly in the group of patients with posttraumatic or postoperative abscess [9]. No organism is identified in the abscess material in 19-42% of patients [8-11]. In our study we found that the most common isolated organism was MRSA (26.7%), then S. pnumoniae (6.7%). No organism was identified in (40%) which coincided with our results.

In this study, we chose the type of management either medical or surgical according to our suggested algorithm for the management. Medical treatment was the choice in case of cerebritis, or small lesions (<2.5cm), or multiple abscesses especially if small, or abscesses in poorly accessible location, or if the duration of symptoms was less than 2 weeks as long as the patient's condition was stable. They constituted (13.3%) of cases in this study with 100% radiological and clinical improvement, no recurrence and no complications. This showed that medical treatment only can be very useful if the patients were carefully selected and the long course was completed.

Surgical management was chosen if the abscess is was more than 2.5cm, presence of mass effect, the abscess being near to the ventricle, traumatic abscess especially if there is foreign bodies, multiloculated, in cases of failure of medical treatment, or the diagnosis was suspicious.

Twenty six patients were managed surgically. Six patients (23%) underwent excision as a primary surgery and twenty patients (77%) underwent abscess aspiration. We found that three cases out of the twenty (15% of aspiration group) showed failure of repeated aspiration and needed excision with complete radiological improvement after excision. There were no residual or recurrence in the excision group.

The recurrence after complete recovery in this study was five patients (16.6%). After the recurrence the three cases were managed by surgical excision and two were managed medically. One
case had post-operative weakness as a complication after excision of the recurrent abscess.

Conclusion:

Despite advances in diagnosis and treatment, brain abscess remains a life-threatening and important disease. Cases of brain abscess must be evaluated both clinically and radiologically.

The choice of antibiotic agents should be based on culture results when possible. In the absence of positive culture results, therapy with third-generation cephalosporins combined with metronidazole and vancomycin can be considered. Corticosteroids are used when edema is present, and prophylactic treatment with antiepileptic drugs is recommended.

References