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# Current epidemiological trends of brain abscess: a clinicopathological study

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## Current epidemiological trends of brain abscess: a clinicopathological study

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**Abstract:** Aims: To determine the current epidemiological trends, clinical presentation and commonest organism of brain abscess in this part of the country. *Material and Methods:* 104 cases admitted during August 2009 to July 2016 in the Department of neurosurgery of Dr RMLIMS Lucknow were included in the study. Detailed clinical history was taken and detailed neurological examination was done. Relevant laboratory investigations were done as needed along with CT scan and /or MRI brain. Patients were managed by aspiration or surgical excision and aspirated material sent for microbiological examination. Results were collected and analyzed. *Results:* Chronic suppurative otitis media (CSOM) was the commonest cause of infection in 54.81% cases. Trauma was encountered in 10.58%% cases. Other causes were haematogenous spread of infection, dental caries and immunodeficiency. No source could be identified in 23 patients (22.11%). *Conclusion:* Chronic suppurative otitis media (CSOM) is still a major cause of brain abscess in developing country like India which is a benign curable disease and should not be neglected. Prompt diagnosis and treatment allows immediate decompression of mass reduces duration of antibiotic stay and minimizes treatment cost. **Key words:** brain abscess, epidemiology, management

### Introduction

Otogenic brain abscess still constitute the major type encountered in developing countries. This is in marked contrast to the reports from western literature of a decline in otogenic brain abscess.

The development of brain abscess is similar to the formation of an abscess in other parts of

body, the reaction depending upon the virulence of the organism and the resistance of the host. Healthy brain tissue is quite resistant to bacterial infection. Indeed, this likely explains the predisposition of pyogenic abscess to form in regions of prior infarction, trauma or surgery. However, once an inoculum has taken hold in the brain

parenchyma, the absence of lymphatics makes it poorly equipped to fight off the infection. Once established, a series of events transpires on a generally predictable sequence that is divided into four stages based on imaging as well as neuropathological studies. These are stage I of early cerebritis, stage II of late cerebritis, stage III of early capsular formation and stage IV of late capsular stage.

Tubercular brain abscess (TBA) is as rare but serious condition. It resembles a pyogenic brain abscess clinically and radiologically and possesses a problem in diagnosis and treatment. Fungal infections of the central nervous system, once a relatively rare occurrence, are increasingly common due to the expansion of immunocompromised populations at risk, and therefore are important to recognize early and manage appropriately.

The objective of this study is to find out the incidence of brain abscess in different age group and sex of the population catered by this institution along with the commonest source of infection and type of management needed in most of the cases and overall morbidity and mortality.

### **Material and methods**

The study incorporated all cases of brain abscess treated in Department of Neurosurgery of Dr RML IMS Lucknow since August 2009 to July 2016.

#### ***Criteria for inclusion***

All patients with confirmed diagnosis of brain abscess on the basis of clinical data, CT

scan and MRI were included in this study irrespective of age and sex.

#### ***Workup and management***

Patients were worked up by detailed history of present illness pointing to a septic focus, general and detailed neurological examinations. Apart from routine hematological investigations, all patients were subjected to CT scan or MRI study.

All patients were managed either conservatively or by aspiration (by twist drill, USG guided, stereotactic) or by surgical excision. Pus was sent for slide examination (gram staining, Z-N staining for AFB, Indian ink staining) and culture and sensitivity test (Aerobes, Anaerobes). Third generation cephalosporin and metronidazole were given in all patient empirically which were subsequently changed after culture and sensitivity report. Treatment for primary focus was also advocated as per direction of concerned department. All patients were followed up for at least three months and observed for recurrence and neurological sequelae. All the relevant data were collected and analyzed.

### **Results**

#### ***Age and sex Distribution:***

Out of a total of 104 patients, 78 were male and 26 were female, thus male and female ratio was 2.71:1

This table showed age wise incidence of the cases. Majority of the patients (73.08%) were below 20 years of age. Youngest patient was of 2 months of age and the oldest was 63 years old.

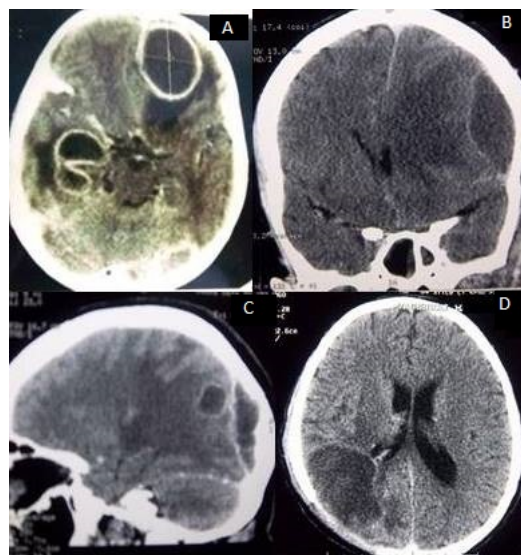
**TABLE 1**  
**Age Distribution**

Age group	Total no. of cases	Male	Female
0-10	33 (31.73%)	24 (23.07%)	9 (8.65%)
11-20	43 (41.35%)	33 (31.73%)	10 (9.61%)
21-30	14 (13.46%)	10 (9.61%)	4 (3.84%)
31-40	5 (4.81%)	3 (2.88%)	2 (1.92%)
41-50	3 (2.88%)	2 (1.92%)	1 (0.96%)
51-60	3 (2.88%)	2 (1.92%)	1 (0.96%)
61-70	3 (2.88%)	1 (0.96%)	2 (1.92%)

#### ***Aetiological Factors***

Chronic suppurative otitis media was the commonest source of infection. A total of 57 cases (54.81%) developed brain abscess secondary to discharging ear. The duration of ear discharge was from few months to many years. In 10 cases, Hematogenous spread of infection from remote area was the cause of brain abscess. Cyanotic heart disease was aetiological factor in four cases (Figure 1A). In one case the source of infection was dental caries. Two cases were associated with HIV infection, among which one case was of fungal origin. Trauma was detected as the cause in 11 cases. Meningitis was the culprit in 3 cases; one of them of paediatric age group presented with subdural empyema along with parenchymal abscess (Figure 1B& 1C).

No source was identified in 23 cases and none of abscess developed following paranasal sinus infection. Two of our cases were having deficiency in cell mediated immunity (HIV). Two cases were found following surgery for head trauma in the post op period (Figure 1D). The Empyema thoracic was the cause of abscess in one case.



**Figure 1** - Multiple brain abscesses in a patient of cyanotic heart disease (A). Subdural empyema developing in a child as a sequel of meningitis (B). Subdural empyema with intraparenchymal abscess in a patient as a complication H. Influenza meningitis(C). Parietal abscess developing following surgical decompression in a head injury patient (D)

#### ***Clinical Presentation***

Majority of cases (88%) reported between 15 to 35 days duration of illness i.e. in the stage of late capsule formation and thus having well defined capsule. At presentation, 85 patients (81.73%) were having symptoms suggestive of raised intracranial pressure i.e. headache and vomiting. There was mild to moderate degree of fever in 61(58.72%). 21 cases (20%) presented with seizure whether focal or generalized. 34 patients had altered sensorium ranging from drowsiness to deep coma. 33 cases (31.80%) had focal neurological deficit in the form of hemiparesis, cranial nerve weakness, dysphasia, and cerebellar signs.

### **Location of Abscess**

Temporal lobe was the site in 27 cases (25.96%) with or without extension to parietal lobe, whereas cerebellum was involved in 16.35% of cases. 21 patients had frontal abscess and 13 had frontoparietal location. Multiple abscesses were found in 8 cases and kept in separate group irrespective of intracranial location. 2 patients had thalamic abscess. 6 (5.77%) were associated with either subdural empyema or epidural abscess. In 2 cases, interhemispheric subdural abscess was found (Figure 2).



**Figure 2** - Contrast enhanced CT scan shows well defined ring enhancing lesions with perifocal edema suggesting abscess in left frontal (A) and temporal region (B). Axial cuts through posterior fossa showing left cerebellar abscess with subdural empyema (C) well defined abscess in right cerebello-pontine cistern with marked mass effect and hydrocephalous (D)

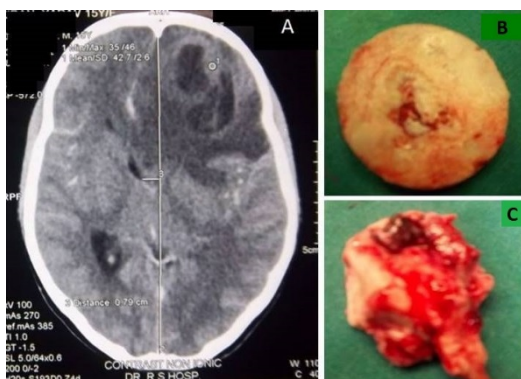
### **Microbiological Examination**

Pus culture was positive in only 57 cases (54.56%). Streptococcus was the commonest offending organism seen in 21 cases followed by staphylococcus (n = 13) and pseudomonas (n = 3). Culture was sterile in 47 cases (45.44). Anaerobes were found in 6 cases (5.77%) where bacteroides species was the principal isolates. In 9 cases (8.65%) mixed organisms were found. Mycobacterium was isolated in 4 cases (Figure 3A) out of which 2 cases were associated with pulmonary kochs. Within 2 fungi cases, candida was associated with HIV infection.

### **Management**

Since most of the cases presented in early and late capsular stage, they managed directly by excision of abscess cavity. 78 cases (75.00%) were managed by direct excision. 9 cases (8.65%) were managed by preliminary aspiration followed by excision because of deteriorating consciousness. 12 cases (11.54%) were managed only by repeated aspiration. Conservative treatment was given to the abscess in cerebritis stage, multiple abscesses and small solitary abscess. Two cases of cerebritis stage were subjected to operation when showed sign of deterioration on conservative treatment. All multiloculated and cerebellar abscesses were managed by surgical excision (Figure 3B& 3C). All the cases, irrespective of surgical procedure, received antibiotics either single or in combination. During last 5 to 6 year, a combination of ceftriaxone and metronidazole were started in every case and changed subsequently after culture report. Those cases showing sterile culture showed good response to both drugs.

Those cases which were managed conservatively, received antibiotics for 4-6 weeks including 2 weeks of intravenous therapy while those cases which were treated by direct excision, received antibiotics only for 3 weeks.



**Figure 3** - Post contrast axial CT image shows thick walled conglomerated ring enhancing lesions with marked perifocal edema and mass effect in left frontal region suggesting tubercular brain abscess (A). Eroded trephine bone flap (B). Excised abscess wall (C)

### Outcome

Overall mortality in this series was 10.58%. Patient with cyanotic heart disease and those having multiple abscesses had the highest mortality. Those patients who were having low GCS and features of herniation died even after surgery. Those cases having GCS below 8 had 62.50% mortality, while mortality was only 1.45% in the patient having GCS between 13 to 15. Four cases which were being treated by repeated aspiration died and one died who was put on conservative treatment. Three patients died among direct surgical excision group.

There were 5 cases of recurrence, three of them were those who did not go for operation for otitis media i.e. eradication of primary

focus and two recurrent cases were those which were infected by pseudomonas and had aspiration only. All patients received antiepileptic drug post-operatively and only two cases had generalized seizure in spite of AED. All the patients presented with focal neurological deficit, improved either during post-operative hospital stay or follow up period, except solitary case of pyocephalus who remained in vegetative state till one year of follow up.

### Discussion

#### *Incidence*

The incidence of brain abscess depends on geographical location and living standard within a given region. In our study, the incidence among all intracranial space occupying lesion was 20.8% which is much higher than other studies. Bhatia et al (1973) [1], Menon, Bhardwaj et al (2008) [2] reported incidence of brain abscess 8%, 8.2% and 15% respectively. Again according to incidence our study highlighted the increase incidence as compared to other studies as mentioned above. This may be due to low socioeconomic status and poor living condition of the population catered by this institute. Besides that, improvement in health care delivery system has led to more and more cases coming up for medical advice and being diagnosed by technological advancements.

#### *Age and Sex Distribution*

In our study, there were 76 males and 28 females. Male preponderance amongst cases were seen as 2.71:1. This may be due to discrimination in seeking medical advice on the basis of sex by local population and exposure of male population to trauma more

than female. In other studies also, the incidence of brain abscess is more in male as compared to females. This predilection for males is unexplained in most series.

In our study, majority of cases (73.08%) were seen in first two decades of life. The main aetiological factors of abscess in our series, like CSOM, CHD and trauma were mostly found in this very young age group. Most other studies like Gupta et al (1990) [3], Menon and Bhardwaj et al (2008) also showed high incidence in first two decades of life as 67.5%. Brain abscess in neonates and infants is rare but our study showed higher incidence due to low socio economic status and poor hygiene.

#### ***Aetiological Factors***

The incidence of contiguous spread of infections into brain parenchyma is decreasing in the most parts of the world, especially in advanced countries, with prompt treatment of the initial source of infection. But in most of the large series of brain abscess from developing countries, mastoid infection still remains to be the commonest source of intracranial abscess.

The present study encountered large number of intracranial abscess secondary to middle ear infection (58.95%), which probably reflects the gravity of ear infection about which people of this particular area are not aware. Similar results have been reported in other study from India (Bhardwaj& Joshi 1998, Lakshmi et al 1993) [4]. This clearly indicates that an ear infection is often neglected and not treated aggressively in developing countries, while in developed countries the incidence of CSOM had come down to 0.04% of all ear infection (Osma et al, 2000) [5].

With the increasing incidence of road

accidents, head trauma had become an important predisposing factor of brain abscess. In our series, it was 10.58 %, while Morgan et al (1973) [6], Gupta et al (1990) and Menon& Bhardwaj et al (2008) observed it in 13.63%, 16.25% and 8% respectively. We found two cases of brain abscess due to deficiency in cell mediated immunity i.e. AIDS. In 22.11% of cases in our study no focus of primary infection was found which was comparable with other study.

#### **Clinical Presentation**

##### ***Location***

In our series 55.77% of abscess was located in supratentorial compartment. In most of the other series, the abscess was located mainly in supratentorial region where temporal, frontal and parietal lobes were commonly affected. Thus it is well evident that temporal lobe was the commonest site in those series including ours where middle ear infection was the main aetiological factor.

##### ***Microbiology***

In our series streptococci and staphylococci was the commonest organism isolated. Berlitz et al, 1996; [7], Estivado et al, 1995; [8], Malik et al, 1994 also reported these organism as commonest. Upon reviewing the literature the overall incidence of pseudomonas as the causative organism has been found to be low. In our series pseudomonas cases were found mostly in otogenic group. Multiple drug resistance was found to be the major problem in pseudomonas infection leading to recurrence and mortality.

For 47 (45.44%) specimens in this study, no organism was isolated from culture. The high incidence of such cultures may be because the

samples were collected from a tertiary care centre and patients had undergone a treatment of long duration with broad spectrum of antibiotics before they reported to the hospital. It has been previously reported that in 9–63% of primary pus specimens, no organism was isolated upon culture [9].

Mycobacterium was found in 4 cases (3.85%) of all brain abscess cases in our study. Out of which 2 cases (50%) were associated with pulmonary Koch's in contrast to 1 of 6 cases (16.67%) in Raj kumar et al's series (2002) [10]. The difference may be due to small sample in the study. Fungal abscess was found in 2 cases (1.92%); Aspergillus species was isolated from one of the HIV infected case which succumbed in long treatment. Scully, Baden and Katz et al (2008) documented similar high fatality of CNS aspergillosis.

## **Management**

### ***Non-Operative Management***

In our series, 3.84% of cases were treated non-operatively which included either abscess in cerebritis stage or deep seated abscess or solitary abscess having diameter less than 2.5 cm. The mortality in this group was 9.09 %. Rosenblum et al (1980) [11] documented complete resolution of abscess with medical therapy where abscess was of less than 2.00 cm in diameter.

### ***Surgical Management***

In this series, we have had better results with excision of capsule either directly or proceeded by aspiration. About 84% of the patients in this series treated by surgical excision of capsule with resultant mortality of about 5.22% while only 11.54% of patients treated by aspiration alone with 33.33%

mortality. The aspiration group included most of case of abscess caused by cyanotic heart disease resulting in high mortality.

Since majority of the cases in this series was having large abscess with well-defined capsule and was showing significant mass effect on CT scan with sign of raised intracranial pressure, excisional surgery was done in them. And all of them received antibiotics only for 3 weeks postoperatively showing no recurrence on the part of antibiotic therapy. Thus excision allows immediate decompression of mass and reduces the duration of antibiotic therapy and consequently resulting in shorter hospital stay and low cost of treatment.

## **Outcome**

The most important determinant of the outcome is the neurological condition of the patient at the start of treatment. The other factors that contribute to mortality are the age of the patient, multiplicity of abscesses and the nature of the infection. Improvement in microbiological isolation technique, newer and most effective antibiotics have significantly reduced the mortality.

The overall mortality in present study was 10.58% and a statistically significant association was shown between the age of the patient and mortality. In our series mortality was approximately 63.72% in comatose patient. Garfield (1969) [12], Karandonis et al (1975); [13] Bhatia et al (1973) all reported approximately 90% mortality among comatose patient. Thus we can see that mortality statistics has not changed significantly since past for comatose patient, which is the important determinant of outcome. We could not find any significant



association between the causal organism and mortality. In the present study 2 patients (18.18%) who died had multiple abscesses.

In this study we did not find significant neurological deficit and disability in cured group. All neurological deficits found at the time of presentation, improved completely in due course of time during follow up. Beller et al (1973) [14] reported 50 percent and Carey et al (1972) [15] reported 35 percent incidence of permanent neurological sequelae following brain abscess. There was one case of pyocephalus who remained in vegetative state post operatively.

### Conclusion

There has been a decrease in mortality due to brain abscesses since 1975, as seen in different studies. This may be due to advances in diagnostic modalities, antibiotic regimens and surgical techniques. Paracranial suppuration is still the most common source of intracranial abscesses in India, with no major change in bacteriology. Earlier diagnosis and aggressive treatment of these conditions will certainly reduce the incidence of such brain abscesses.

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