

Original Research Article

Clinical outcomes following surgical management of brain abscess in a tertiary care centre: retrospective analysis of 56 cases

V. V. Ramesh Chandra, B. C. M. Prasad, V. Niranjana*, Nitin Manohar Barde

Department of Neurosurgery, Sri Venkateswara Institute of Medical Sciences, Tirupati, Andhra Pradesh, India

Received: 24 December 2019

Accepted: 30 December 2019

*Correspondence:

Dr. V. Niranjana,

E-mail: neeru4050@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Despite the advent of newer antibiotics and surgical strategies, the overall outcome and quality of life issues in Brain Abscess (BA) patients remain a continuous challenge for the neurosurgical community.

Methods: Fifty-six patients with BA are analyzed retrospectively, that treated between January 2014 and June 2019, according to age, the clinical symptoms, etiologic factors, infecting organisms, prognostic factors, localization, diagnostic and treatment methods and outcome.

Results: In acute cases, common clinical features were headache, fever, vomiting, focal deficit and seizure. In chronic abscesses, common clinical features were mild to moderate headache and progressive focal deficit. In 12(21.42%) patients had adjacent localized sinus, middle ear infection. In 27(48.21%) patients no primary source of infection was identified, predisposing factors included post neurosurgery (8.92%), post penetrating injury (3.57%), and congenital heart disease, infective endocarditis, sinusitis. The frontal lobe involved in 28.5% cases, temporal lobe and cerebellum are next to be involved. Burr hole aspiration in 29(51.78%) cases, a craniotomy was done in 15(26.78%) cases. Pus culture was negative in 36 (64.28%) cases. Mortality was noted in 2(3.57%) cases. Complete resolution of the abscess with complete recovery of preoperative neuro-deficit was seen in 71.42% cases and recovery with major neuro-deficit was observed in 16.07% cases. The best outcome was seen with a better Glasgow Coma Scale (GCS) on admission.

Conclusions: BA, when surgery is required, should be done on an emergency basis. BA treated with burr hole aspiration shows excellent clinical and radiological response. A craniotomy is required in selected cases and is a primary procedure in cerebellar, postoperative and posttraumatic abscesses. Broad-spectrum antibiotic therapy should be administered for a period of minimum 6 weeks to prevent relapse.

Keywords: Brain abscess, Burr hole aspiration, Ring enhancing lesions of brain

INTRODUCTION

Brain Abscesses (BA) often occur in the developed world, and they are even more common in developing countries.¹ In spite of the advent of modern neurosurgical techniques, including stereotactic brain biopsy and aspiration, better culturing techniques to identify the infectious agent, new antibiotics, and modern noninvasive neuroimaging procedures, BA still poses a public health challenge, especially in developing countries.^{2,3} Currently, in high-income countries, the

original forms of the intracranial suppurative disease (i.e., BA, empyema, and purulent ventriculitis) are so uncommon that most young neurosurgeons are unfamiliar with this form of pathology and recognizing the need at times for judicious, complex, and aggressive surgical management.⁴ The infectious origin of the BA causes significant damage to the CNS, because of its incapability of mounting a sufficient defense against the microorganism, leading to a pyogenic abscess.^{5,6} There are enormous diagnostic and therapeutic challenges and controversies in the management of brain abscess. Here,

Authors report their experiences including preoperative clinical features, radio-imaging findings, surgical interventions, postoperative course, complications, risk factors, causes, and outcomes in the management of BA.

METHODS

Study population constitutes total of 56 patients who were diagnosed of BA. All 56 patients included in the study underwent surgery in Sri Venkatesara Institute of Medical Sciences (SVIMS), between the period of January 2014 to June 2019. Retrospectively collected data includes clinical presentation, neurological status at admission, radiological imaging, predisposing factors, anatomical location, number of lesions, surgical techniques, complications, cultured organisms, and the neurological outcome were studied. BA patients who were managed conservatively and BA patients who underwent initial surgery at an outside center and referred to authors institute for recurrence were excluded from the study. CT and/or MRI were used in all cases for diagnosis and follow-up. The surgical intervention consists of an emergency tapping of abscess or craniotomy with resection of the abscess, for deep-seated abscess near to ventricle endoscopic abscess drainage done. The surgical procedure was performed under local or general anesthesia for abscesses larger than 2.5 cm, signs of brain herniation secondary to Space-Occupying Lesions (SOL) or ventricular proximity, abscess growth during medical therapy or SOL of uncertain etiology associated with neurological deterioration. The evolution of the lesions was radiologically evaluated by CT scan or MRI performed in the case of neurological deterioration or at the end of 6 weeks of antibiotic therapy. After a full course of antibiotics, cerebral CT was repeated every month for 6 months or until all abscesses resolved.

RESULTS

Demographics

Total number of patients in the present study were 56(30 males, 26 female) aged 1.5-75years (mean 31.9 years). 13(23%) out of 56 patients were in the pediatric age group. And the duration of symptoms on average were 13 days ranging from 3-35 days.

Signs and symptoms

On admission, 71% of the patients had a headache. (Table 1) shows the presenting signs and symptoms of the patient in the study. 46(82%) out 56 were an acute pyogenic abscess and 10 chronic abscesses. Among the chronic abscess, 2 were a chronic pyogenic abscess, 7 were tubercular, and one case malignant brain metastases. At the time of admission, presence of a focal neurological deficit (i.e., hemiparesis, aphasia, visual defects) was noted in 43% of patients symptoms, and signs of intracranial hypertension (headache, nausea, vomiting, papilledema) was noted in 44%, alteration in the level of

consciousness was noted in 9% of patients. Seizures (generalized or partial) occurred in only 6 cases (11.38%). 30 patients had a fever (54.3%) and signs of meningeal irritation were observed in 3 cases (5.5%). The classical triad of BA (fever, headache, and focal neurological deficits) was present in only 6 patients (11.53%).

Table 1: Symptoms and signs.

Symptoms and signs	No. of patients	%
Headache	40	71
Nausea and vomiting	16	29
Papilledema	8	14
Altered state of consciousness	5	9
Focal neurological deficits	24	43
Seizures	6	11
Fever	30	54
Signs of meningeal irritation	3	6

Source of BA and predisposing factors

The primary source of infection was not identified in 27 patients (48.21%). The most common cause of BA in this study was not known. Hematogenous spread (10 cases-17.85%), 7 patients with Cyanotic Heart Diseases (CHD), 2 patients with bacterial endocarditis, 1 patient with lung abscess. The contiguous spread was identified in 12 cases (21.42%): 8 patients with middle-ear and mastoid air sinus infections, and 4 patients with paranasal sinusitis. Five BA due to a post-surgery nosocomial bacterial infection were noted (8.92%). In 2 patients, BA were observed following penetrating cranial trauma (3.57%). Predisposing factors for developing opportunistic or atypical infection were noted in many cases: one patient was on long term use of immunosuppressant drugs for renal transplant and 34 were diabetic patients of them 6 had uncontrolled diabetes mellitus, cardiac morbid conditions. Table 2 shows the sources of abscess.

Table 2: Sources of brain abscess.

Source of brain abscess	No. of patients	%
Contiguous spread (middle-ear and mastoid air sinus infection)	12	21.42
Hematogenous spread (cyanotic heart disease, lung abscess, bacterial endocarditis)	10	17.85
Post neurosurgical procedure	5	8.92
Post penetrating head injuries	2	3.57
Unknown	27	48.2

Location of BA

The most common location for solitary abscesses was the frontal lobe (16 cases-28.57%), followed by the temporal (12 cases-21.42%), 12(21.42%) cases in the cerebellum, parietal (9 cases-16.07%). There were 2 abscesses in the

basal ganglia and thalamus. Sinogenic abscesses were located in the frontal lobe, whereas otogenic abscesses were located mainly in the temporal lobe and cerebellum. Multiple abscesses were located in more lobes. There were two cases of intraventricular rupture of BA in this series. There were 48 solitary (85.71%) and 8 multiples (14.28%). Table 3 shows location of BA.

Table 3: Location of abscess.

Location	No. of patients	%
Frontal lobe	16	28.5%
Temporal lobe	12	21.42%
Parietal lobe	9	16.07%
Parieto-occipital lobe	5	8.92%
Cerebellum	12	21.42%
Basal ganglia and thalamus	2	3.57%

Microbiology

In 36(64.28%) patients no micro-organism was isolated and in 14(23%) patients' multiple organisms were identified. The organisms were more than two in five patients. The most isolated micro-organisms were Staphylococcus species Proteus species. Five cases were tuberculosis abscesses. The majority of cases in the present study were referred from other centers, so the antibiotic course was started, as a result, culture could not isolate any specific organism. Figure 1 shows the organism isolated from culture.

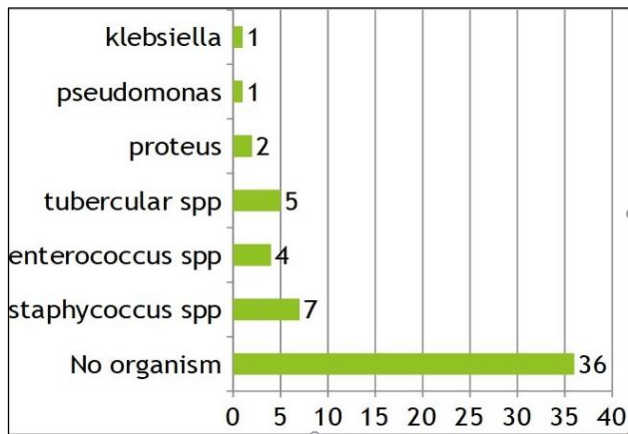


Figure 1: The organisms isolated from culture.

Treatment modality

The treatment of choice for BA in the present study was tapping and aspiration of an abscess and sending it for culture sensitivity. 29(51.78%) of 56 patients were treated initially with a burr hole and aspiration of abscess. 15 patients (26.78%) required craniotomy, of the three patients, initially had undergone burr hole and did not improve so had to be taken for craniotomy and excision of the abscess. The type of craniotomy was decided by the location of the BA. In the present study, posterior

fossa abscess was treated by suboccipital craniectomy in 10 people and all 10 had a favorable outcome. In two cases in which thalamic abscess was ruptured into ventricles with subsequent development of hydrocephalus, Endoscopy was used to drain the abscess and to perform ETV. Table 4 shows various surgical procedures performed in present series. Figure 2 shows MRI images of a thalamic abscess patient who underwent endoscopic drainage and ETV.

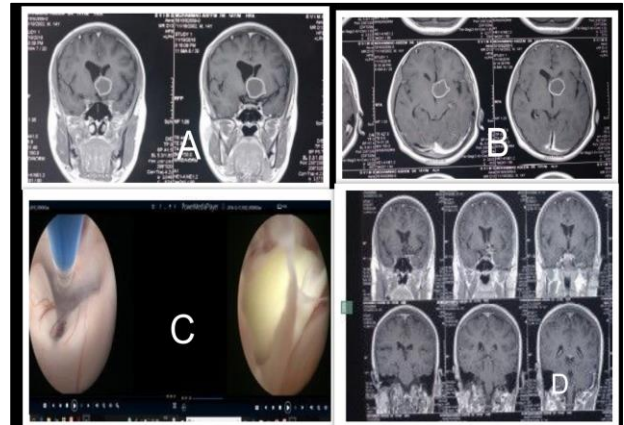


Figure 2: A) MRI coronal section showing thalamic abscess with compression over ventricles, B) MRI axial cuts of same patient, C) Intraoperative endoscopic pics of same patients showing yellowish color pus, D) Follow up MRI of the same patient after six weeks post-surgery after completion of antibiotic therapy showing complete resolution of the abscess.

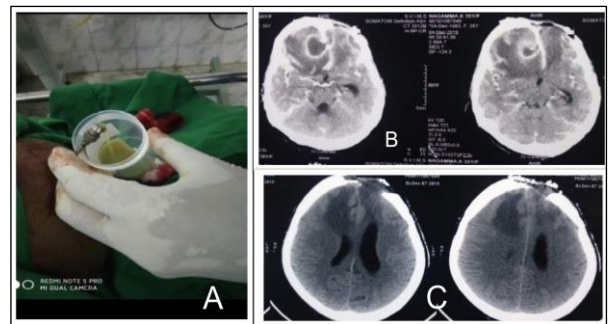


Figure 3: A) Intraoperative pic showing the collection of pus in a specimen bottle, B) CT scan image of the patient with brain abscess following treatment for a depressed fracture, C) CT scan image of the same patient showing complete resolution of the abscess.

Table 4: Type of surgical procedure.

Type of surgical procedure	No. of patients	%
Burr hole or twist drill aspiration	29	51.78%
Craniotomy	15	26.78%
Sub occipital craniectomy	10	17.85%
Endoscopic drainage and ETV	2	3.57%

Table 5: Neurological deficits in treated brain abscess patients.

Characteristics post operatively	No. of patients
Who had complete relief of symptoms	40(71.42%)
With residual neurological deficit post-surgery (hemiparesis, aphasia, visual field deficits, hand weakness, foot drop)	9(16.07%)
Developed recurrence	12(21.4%)
Remained in vegetative state	5
Mortality	2(3.5%)

Table 6: CT findings at various stages of brain abscess.⁵

Early cerebritis (days 1-3)	Partial ring contrast enhancement on day 1 evolves to full ring enhancement by day 3
Late cerebritis (days 4-9)	Ring enhancement with Diffusion of contrast Medium into the lucent Center on delayed scans
Early capsule formation (days 10-13)	Ring enhancement with less diffusion of contrast material into the lucent center
Late capsule formation (after and Including day 14)	Ring enhancement without diffusion of contrast material into the lucent center

Outcome

The total number of deaths was 2(3.5%) cases. Complete resolution of an abscess with complete recovery of preoperative symptoms was observed in 40(71.42%) cases. Complete resolution of an abscess with residual preoperative major neuro-deficit was detected in 9(16.07%) cases. Persistent major neuro-deficit include hemiparesis in 5, aphasia in 3, hand weakness in 7, foot drop in 2, visual field defect in 2. Patients' GCS on admission had a significant effect on mortality in BA. Table 5 shows neurological deficits in treated BA patients.

A total of 12(21.4%) patients had a recurrence, 3 patients underwent retapping and 3 pts underwent craniotomy and 2 patients were managed conservatively under observation and 2 pts expired and the remaining 2 patients are in a persistent vegetative state. Table 6 shows the fate of patients who developed recurrence.

DISCUSSION

BA is a focal intraparenchymal collection of pus and is classified based on the anatomical location or the etiologic agent causing it. It begins as a localized area of cerebritis and evolves into a collection of pus surrounded by a vascularized capsule.⁷ BA occur often in the

developed world, with an incidence of up to 2% of all space-occupying lesions. They are even more common in developing countries, with an incidence of up to 8%.^{1,8}

In the present study males slightly outnumbered females (30 to 26) which were correlating with various studies in the literature. A BA is initiated when micro-organisms are introduced into the brain tissue following trauma, meningitis or hematogenous dissemination from a distant infective focus. Eighty percent of cases have a known predisposing factor. The otogenic source is the commonest cause with a temporal lobe or cerebellar hemisphere as common locations.⁹⁻¹¹ But in the present series in 27(48.21%) of cases, the cause was not known. 12 patients contiguous spread was noted, 10 of them had associated CSOM. And cerebellum was the commonest in these patients. And 10 patients had a hematogenous spread of the seven patients had cyanotic heart disease, BA can develop in 5-18% population with CHD. Individuals with CHD are 10 times more prone to develop BA than those with no CHD. Fallot's tetralogy is the most common cause.^{12,13} In the present study of the seven patients having CHD five of them had Fallot's tetralogy and cardiology consultation was taken before and after the procedure. Intracardiac right to left shunt by-pass allows direct entry of blood containing bacteria to the cerebral circulation without pulmonary filtration. Hypoxaemia, metabolic acidosis and increased blood viscosity from compensatory polycythemia result in low perfusion areas (microinfarcts) in the brain. Microinfarcts provide a milieu where seeded microorganisms can sustain growth and multiply to form an abscess. Anaerobic streptococci are the most common agents. These patients possess cardiopulmonary risk, a wide variety of coagulation defects and a variable degree of immunodeficient states increasing the risk of anesthesia and surgery. Thus, a less invasive surgical procedure such as aspiration should be chosen. Intravenous Beta-lactam antibiotics are started immediately. In present series also all cardiac patients with BA underwent bedside twist drill aspiration of the abscess and starting of antibiotics at the earliest.

Histologically, there are four stages in BA formation: early cerebritis (day 1-3), late cerebritis (day 4-9), early encapsulation (day 10-13) and late capsule stage (day 14 onward). About 2 weeks are required for encapsulation, which is usually less complete on the medial or ventricular side due to poor vascular supply.^{14,15} Necrotic liquefaction and inflammatory exudates accumulate in the abscess cavity, during expansion, the medial wall is thinner and less resistant and may result in ventriculitis. This is a poor prognostic indicator.¹⁶ In present series 36(64.28%) patients no micro-organism was isolated and in 14(23%) patients' multiple organisms were identified. Most of these patients had received broad-spectrum antibiotic therapy before obtaining culture material. The most important factor responsible for sterile cultures was the usage of antibiotics before surgical intervention.^{17,18} The other reason for sterile "cultures" in brain abscess may indeed be in part due to failures of recovering anaerobes which survive only in an oxygen-free

environment and require careful isolation techniques.¹⁹ The most isolated micro-organisms in the present series in culture-positive cases were *Staphylococcus* species, *Proteus* species. Five cases were tuberculosis abscesses. Cultures for acid-fast bacilli and fungi should be conducted in all cases. In recent years, anaerobic micro-organisms are being frequently isolated from BA.²⁰ Authors noted only three cases in which anaerobic bacteria (*klebsiella* and *proteus* which are facultative anaerobes) were isolated. The organism isolated from culture depends on the patient's age, site of primary infection, and the patient's immune status. Due to widespread use of parenteral hyperalimentation, aggressive chemotherapy, corticosteroids, and other immunosuppressive therapies, as well as in intravenous drug abusers and transplant patients, the risk of fungal infection such as *Candida albicans*, *Aspergillus* species, etc., is increasing.²¹ In the present series, a post renal transplant patient developed BA. In the present series 48 solitary (85.71%) and 8 multiples (14.28%), the abscess was noted. The incidence of multiple abscesses was reported to be 10-50% in different series, and as high as 61%, especially in the series of infants.²² In the present study, it was 14.28% (meaning 8 out of 56 patients). In the early series, the mortality rate in patients with multiple BA was higher than in solitary BA.²³

The reasons for the high mortality of these patients were a delay in diagnosis and a lack of aggressive antibiotic therapy. In this study, the prognosis of multiple abscesses was similar to solitary ones.

The clinical features in patients with intracranial abscesses evolve with time as a result of the size and location of the lesion and depend upon interactions between the virulence of the pathogen and host immune response.²⁴ The common findings result from raised Intracranial Pressure (ICP), and focal neurological deficits due to compression and seizures. These include headaches, found in up to 71% (in present series) of cases, nausea and vomiting, papilledema, and altered mental status. The triad of fever, focal neurological deficit, and headaches is found in only 6 patients in the present study. Patients with a thalamic abscess had rupture of abscess into the ventricle and presented with hydrocephalus, lumbar puncture is contraindicated in patients with a suspected BA because it can result in transtentorial or transforaminal herniation and subsequent death.²⁵ It is usually performed under strong suspicion of concomitant meningitis and/or ventriculitis in the absence of increased ICP. Of the 5 patients having tubercular abscess 3 had concurrent tuberculosis in another system.

Neuroimaging, usually a CT scan with contrast, is essential to diagnose a BA. The typical finding on CT scan or MRI is a hypodense lesion with a contrast-enhancing ring. CT facilitates early detection, exact localization, and accurate characterization, determination of number, size, hydrocephalus, ICP, edema and

associated infections like subdural empyema, ventriculitis and thus helps in treatment planning, in the assessment of the adequacy of treatment and sequential follow-up. On contrast CT, uniform ring enhancement is virtually always present in later phases. The central area of liquefaction gives high signals, while the surrounding edematous brain tissue gives low signals on T1-weighted images. On T2-weighted images, the necrosis shows higher signals similar to the gray matter. The zone of inflammation is significantly thicker in tubercular as compared to a pyogenic abscess in morphometric analysis of histologic sections. Thickness, irregularity, and nodularity of the enhancing ring are suggestive of the tumor (the majority of cases) or, possibly, a fungal infection. Radiological features alone are inadequate to differentiate pyogenic BA from a fungal, nocardial or tuberculous abscess, inflammatory granuloma (tuberculoma), neurocysticercosis, toxoplasmosis, metastasis, glioma, resolving hematoma, infarct, hydatid cyst lymphoma, and radio necrosis. However, fever, meningism, raised ESR, multilocularity, leptomeningeal or ependymal enhancement, reduction of ring enhancement in delayed scan and finding of gas within the lesion favor a diagnosis of an abscess. DWI, which usually shows restricted diffusion (bright signal) that helps to differentiate abscesses from necrotic neoplasms, which are not usually restricted, although not all abscesses follow this rule. Proton MR spectroscopy (1H-MRS) is also a safe, noninvasive imaging modality and can accurately differentiate between necrotic/cystic tumor and cerebral abscesses.

DWI distinguishing abscess (low ADC) from the necrotic tumor (high ADC). Spectroscopy and DWI raised sensitivity and specificity of MR for an abscess from 61.9% and 60.9% to 95.2% and 100%, respectively. MRS spectra in patients with abscess showed lactate, amino acids (including valine, alanine, and leucine), and acetate peaks while spectra for patients with cystic or necrotic tumors showed only lactate peaks. Table 6 shows various CT findings at various stages of BA. And Table 7 shows features that help in differentiating BA from other ring-enhancing lesions.

The indications for surgery were lesions with significant mass effect, rupture of abscess into the ventricle, evidence of significant increased ICP. Generally, medical management for abscess is advised on individual basis but generally, conservative approach is advised only those with a small abscess (<2 cm), and for whom the etiology is well-known (microorganism isolated from material other than the abscess pus) or in the case of multiple abscesses, after surgery of large abscess has been done for remaining smaller abscess, or for a patient who is unfit for surgery because of his medical conditions. According to the "Infection in Neurosurgery' Working Party of The British Society for Antimicrobial Chemotherapy," the guiding principles for surgical management are:²⁶

Table 7: Features that help in diagnosis of brain abscess.

Abscess	Ring enhancement, Thinning of the internal border of the capsule on post-contrast CT
	Hyperintense centre, Hypointense border on T2
	Hyperintense on DWI, Hypointense on ADC
	MRS showed lactate, amino acids (including valine, alanine, and leucine), and acetate peaks
High-grade neoplasm	Solid enhancement in most, A minority will not enhance on post-contrast CT
	Non-necrotic lesions may appear isointense on T2
	Necrotic lesions Hypointense on DWI, Hyperintense on ADC
	cystic or necrotic tumors showed only lactate peaks on MRS
Metastases	Ring or solid enhancement on post-contrast CT
	Typically, hypointense on DWI, Hyperintense on ADC

- To urgently reduce raised intracranial pressure by aspiration of the cavity
- To confirm the diagnosis
- To obtain pus for microbiological diagnosis
- To enhance the efficacy of antibiotic therapy
- To avoid the iatrogenic spread of infection into the ventricles.

Currently, the methods for surgical management are open excision, and aspiration through a burr hole and more recently stereotactic.^{4,27} Surgery was performed in all 56 patients in the study. Of the 29(51.78%) underwent burrhole aspiration of the abscess, and 15(26.78%) of them underwent craniotomy and excision of the abscess. And 10(17.85%) patients underwent suboccipital craniectomy.

In most instances, aspiration of the purulent material is sufficient to initiate the healing of abscess. Figure 3 shows aspiration of pus from an posttraumatic abscess patient. However, surgical excision becomes mandatory if the pus is thick and in multiloculated abscesses. Urgent evacuation of the abscess is required for subdural empyema and cerebellar abscess. In the present series, the initial choice was burr hole aspiration of BA, but craniotomy was done if Nonresponse BA to only medical management (i.e., evidence of growing abscess while on antibiotics or no change in size at 2-3 weeks), will necessitate surgical drainage.

In the present series of 15 patients who underwent craniotomy three patients initially had undergone burr hole and did not improve so had to be taken for craniotomy and excision of the abscess.

The traumatic BA may require craniotomy to remove foreign material or bone chips. Cerebellar or brain stem abscesses are often an indication for posterior fossa craniotomy due to the high risk of brain herniation.

Multiple abscesses are best treated by aspiration of the largest one for diagnosis and others if they are causing mass effect. Where a peripherally placed abscess fails to respond to aspiration consideration should be given to craniotomy and excision; In this study, 2 patients underwent endoscopic drainage of thalamic BA ruptured

into the ventricle and followed by ETV. Today, aspiration of BA has become the preferred method of drainage, for providing rapid relief from raised ICP for single or multiple, deep- and/ or "eloquent area" located lesions, it is considered easy to perform; main disadvantages of aspiration are repeat procedures and, in up to 70% of patients, there is possibility of iatrogenic puncture of the ventricle and subarachnoid leakage of pus leading to meningitis and/ or ventriculitis.²⁷ In 2010, Tan et al.²⁸ compared the burr hole approach versus craniotomy used as a treatment for superficial BA and its outcome in terms of radiological clearance on brain CT, improvement of neurological status, the need for repeated surgery, and survival and morbidity at three months after surgery. They found that patients who had undergone craniotomy and excision of abscess showed a significantly earlier improvement in neurological function, better radiological clearance, and lower rate of surgery as compared to the burr hole aspiration group, but with no significant difference between the two surgical methods regarding to neurological improvement at 3 months, morbidity, and mortality. In the present study also, patients treated with burr hole aspiration had no major difference on long term follow up. Steroids are recommended perioperatively for reducing ICP and avoiding acute brain herniation, but only in those patients that demonstrate signs of meningitis or disproportionate cytotoxic edema posing a life-threatening problem.²⁹ In the present study, steroids were used in 14 patients to reduce edema, to good effect.

Postoperative anticonvulsants

Seizures can be the initial manifestation of BA in up to 25-43% of cases.³⁰ In the present series 11% of patients had seizures. Legg et al, followed BA patients for long periods (up to 30 years) and founded an incidence of subsequent seizures after BA near 70%.³¹ They advocated anticonvulsant therapy for 5 years to all patients with BA.³¹ In the case of children, anticonvulsants are recommended in those who have developed seizures to potentially prevent further episodes. The duration should be individualized and guided by EEG studies in the follow-up phase of the disease. In the present study, antiepileptics were advised for 2 years post-surgery further continuation was determined by repeat

Electroencephalogram (EEG) was done to note for any epileptic activity and seizure-free period of more than 3 months.

Mortality and recurrence

Total 12(21.4%) patients had a recurrence but of the 3 patients who underwent retapping and 3 pts underwent craniotomy and 2 patients were managed conservatively under observation and 2 pts expired and the remaining 2 patients are in a persistent vegetative state. The total number of deaths was 2(3.5%) cases. Totally 5 patients remained in a vegetative state.

Table 8 shows a comparison of the present study with other studies from the literature. Arlotti et al, consider 4-6 weeks of treatment for surgically treated abscesses, and 6-8 weeks for intravenous treatment for BA treated solely medically and in the case of multiple BA when larger

ones are treated surgically.³² Usually, "triple high dose" antibiotics intravenously for 2 weeks followed by 4 weeks of oral therapy is recommended. In the present study all surgically treated solitary BA were given antibiotics for 6 weeks, then for multiple abscesses where one single larger one was aspirated 8 weeks where given. The antibiotic used was decided by the culture. When the culture was negative, authors used IV cefotaxime + metronidazole was giving the first two weeks IV and remaining period oral. Untreated cases of brain abscess are lethal. The most significant predictors of poor outcomes are the patient's preoperative level of consciousness and the rapidity of disease progression before initiation of treatment, underlying medical conditions, a deep-seated location, and intraventricular abscess rupture causing ventriculitis. Mortality decreased in the present study because of early diagnosis and immediate surgical management followed by effective antibiotic therapy.

Table 8: Comparison of present study with other studies in literature.

Name of the study	Present study	M. Radoe et al, ³³	D.Muzumdar et al, ³⁴	E. Tonon et al, ³⁵	M. Takeshitha et al, ³⁶
Type	Retrospective	Retrospective	Retrospective	Retrospective	Retrospective
No. of cases	56	52	289	100	113
Mean age	31.9 yrs.	43.7 yrs.	32 yrs.	44.4 yrs.	-
Male	30(53.5%)	31(59.6%)	204(71%)	--	68
Female	26(46.5%)	21(40.4%)	86 (29%)	- --	45
Culture	Sterile (64%)	Staph (35.8%)	Staph (18%)	Staph (43%)	Sterile 54(47%)
Recurrence	12(21.4%)	6(11.53%)	44(15.2%)	7(7%)	---
Lobe involved	Frontal 16(28.5%)	Parieto -temporal 16(40%)	Parieto temporal 130(44.9%)	Temporal 42(54%)	---
Mortality	2(3.5%)	4(7.70%)	8(2.7%)	8 (8.3%)	13.2%

CONCLUSION

In the majority of cases of BA, predisposing factors are present. Aggressive treatment of the primary source of infection at the right time is essential. Early and proper treatment of compound depressed skull fractures is important and regular follow up of these patients will help in early identification of brain abscess and management.

Training of health practitioners should emphasize on early treatment of paranasal and ear infections. BA, when surgery is required should operate on an emergency basis. BA treated by single burr hole aspiration shows excellent clinical and radiological response. Pus should be sent without any delay with the necessary precautions, not only for bacteriological analysis but also for tubercular and fungal identification as well. A craniotomy is required in only selected cases like cerebellar, post-traumatic, post-surgical, cases recurring after aspiration and cases not improving after aspiration. Broad-spectrum antibiotics should be

administered for all patients of post-surgery for a minimum of 6 weeks. And every BA patient should be compulsorily followed for relapse and recurrence.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: Not required

REFERENCES

- Bernardini GL. Diagnosis and management of brain abscess and subdural empyema. *Current Neurol Neurosci Rep.* 2004 Dec 1;4(6):448-56.
- Wilson HL, Kennedy KJ. *Scedosporium apiospermum* brain abscesses in an immunocompetent man with silicosis. *Medi Mycol Case Rep.* 2013 Jan 1;2:75-8.
- Ansari MK, Jha S. Tuberculous brain abscess in an immunocompetent adolescent. *J Natural Sci, Biol, Med.* 2014 Jan;5(1):170.

4. Nathoo N, Narotam PK, Nadvi S, van Dellen JR. Taming an old enemy: a profile of intracranial suppuration. *World Neurosurg.* 2012 Mar 1;77(3-4):484-90.
5. Britt RH, Enzmann DR, Yeager AS. Neuropathological and computerized tomographic findings in experimental brain abscess. *J Neurosurg.* 1981 Oct 1;55(4):590-603.
6. Manzar N, Manzar B, Kumar R, Bari ME. The study of etiologic and demographic characteristics of intracranial brain abscess: a consecutive case series study from Pakistan. *World Neurosurg.* 2011 Jul 1;76(1-2):195-200.
7. Lai PH, Ho JT, Chen WL, Hsu SS, Wang JS, Pan HB, Yang CF. Brain abscess and necrotic brain tumor: discrimination with proton MR spectroscopy and diffusion-weighted imaging. *Am J Neuroradiol.* 2002 Sep 1;23(8):1369-77.
8. Sharma BS, Gupta SK, Khosla VK. Current concepts in the management of pyogenic brain abscess. *Neurol Ind.* 2000 Apr 1;48(2):105.
9. Rosenblum ML. Controversies in the management of brain abscess. *Clin Neurosurg.* 1986;33:603-32.
10. Keet PC. Cranial intradural abscess management of 641 patients during the 35 years from 1952 to 1986. *Bri J Neurosurg.* 1990 Jan 1;4(4):273-8.
11. Yang SY, Zhao CS. Review of 140 patients with brain abscess. *Surg Neurol.* 1993 Apr 1;39(4):290-6.
12. Moorthy RK, Rajshekhar V. Management of brain abscess: an overview. *Neurosurg Focus.* 2008 Jun 1;24(6):E3.
13. Prusty GK. Brain abscesses in cyanotic heart disease. *Ind J Pediatr.* 1993 Jan 1;60(1):43-51.
14. Joshi S, Devkota UP. The management of brain abscess in a developing country: are the results any different?. *Bri J Neurosurg.* 1998 Jan 1;12(4):325-8.
15. Livraghi S, Melancia JP, Antunes LL. The management of brain abscesses. *Advan Technical Standards Neurosurg* 2003;285-313.
16. Udoh DO, Ibadin E, Udoh MO. Intracranial abscesses: Retrospective analysis of 32 patients and review of literature. *Asian J Neurosurg.* 2016 Oct;11(4):384.
17. Hakan T, Ceran N, Erdem İ, Berkman MZ, Gökteş P. Bacterial brain abscesses: an evaluation of 96 cases. *J Inf.* 2006 May 1;52(5):359-66.
18. Tseng JH, Tseng MY. Brain abscess in 142 patients: factors influencing outcome and mortality. *Surg Neurol.* 2006 Jun 1;65(6):557-62.
19. Yoshikawa TT, Goodman SJ. Brain abscess Teaching Conference, University of California, Los Angeles, Harbor General Hospital, Torrance (Specialty Conference). *West J Med.* 1974;121:207-19.
20. Meis J, Groot-Loonen J, Korstanje JA. A brain abscess due to multiply-resistant *Enterobacter cloacae* Successfully treated with meropenem (letter). *Clin Infect Dis.* 1995;20(6):1567.
21. Singh N, Husain S. Infections of the central nervous system in transplant recipients. *Transplant Inf Dis.* 2000 Sep 1;2(3):101-11.
22. Renier D, Flandin C, Hirsch E, Hirsch JF. Brain abscesses in neonates: a study of 30 cases. *J Neurosurg.* 1988 Dec 1;69(6):877-82.
23. Glenn E, Mathisen, J. Patrick Johnson, Brain Abscess, *Clin Inf Dis.* 1997;25(4):763-79.
24. Muzumdar D, Jhawar S, Goel A. Brain abscess: an overview. *Inter J Surg.* 2011 Jan 1;9(2):136-44.
25. Unnikrishnan M, Chandy MJ, Abraham J. Posterior fossa abscesses. A review of 33 cases. *J Assoc Phys Ind.* 1989 Jun;37(6):376-8.
26. De Louvois, EM Brown, R. Bayston, PD Lees, IK Pople J. The rational use of antibiotics in the treatment of brain abscess. *Bri J Neurosurg.* 2000 Jan 1;14(6):525-30.
27. Hall WA, Truwit CL. The surgical management of infections involving the cerebrum. *Neurosurg.* 2008;62(2):519-30.
28. Tan WM, Adnan JS, Haspani MS. Treatment outcome of superficial cerebral abscess: An analysis of two surgical methods. *Malaysian J Med Sci: MJMS.* 2010 Jan;17(1):23.
29. Lee TH, Chang WN, Su TM, Chang HW, Lui CC, Ho JT, et al. Clinical features and predictive factors of intraventricular rupture in patients who have bacterial brain abscesses. *J Neurol, Neurosurg Psychi.* 2007 Mar 1;78(3):303-9.
30. Ramakrishnan KA, Levin M, Faust SN. Bacterial meningitis and brain abscess. *Medicine.* 2013 Dec 1;41(12):671-7.
31. Legg NJ, Gupta PC, Scott DF. Epilepsy following cerebral abscess a clinical and eeg study of 70 patients. *Brain.* 1973 Jun 1;96(2):259-68.
32. Arlotti M, Grossi P, Pea F, Tomei G, Vullo V, De Rosa FG, et al. Consensus document on controversial issues for the treatment of infections of the central nervous system: bacterial brain abscesses. *Inter J Infe Dis.* 2010 Oct 1;14:S79-92.
33. Radoil M, Ciubotaru V, Tataranu L. Brain Abscesses: Clinical Experience and Outcome of 52 Consecutive Cases *Chirurgia.* 2013;108:215-25.
34. Muzumdar D, Jhawar S, Goel A. Brain abscess: an overview. *Inter J Surg.* 2011 Jan 1;9(2):136-44.
35. Tonon E, Scotton PG, Gallucci M, Vaglia A. Brain abscess: clinical aspects of 100 patients. *Inter J Infe Dis.* 2006 Mar 1;10(2):103-9.
36. Takeshita M, Kagawa M, Yato S, Izawa M, Onda H, Takakura K, et al. Current treatment of brain abscess in patients with congenital cyanotic heart disease. *Neurosurg.* 1997 Dec 1;41(6):1270-8.

Cite this article as: Ramesh Chandra VV, Prasad BCM, Niranjana V, Barde NM. Clinical outcomes following surgical management of brain abscess in a tertiary care centre: retrospective analysis of 56 cases. *Int J Res Med Sci* 2020;8:430-7.