ORIGINAL RESEARCH PAPER

Neurosurgery

INTRACRANIAL ABSCESSES : AN INSTITUTIONAL STUDY.

KEY WORDS: Brain Abscess, Aspiration, Cerebritis.

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ABSTRACT

Background - Brain abscess is defined as a focal intracranial infection that is initiated as an area of cerebritis and evolves into a collection of pus surrounded by a vascularized capsule . These are complications of head trauma, neurosurgical operations, meningitis, and otogenic, mastoid, and paranasal air sinus infections. Management involves both medical or surgical treatment. Surgical management includes either aspiration or excision of lesions larger than 2.5 cm in diameter, depending on brain location. However, literature on surgical treatment is replete with several procedures which, on their own, may not determine outcome.

Aim –Aim is to study the epidemiology, management and outcome of various treatment modalities of brain abscess in our institute.

Material And Methods - We conducted a retrospective study of demographic data as well as indications, treatment modalities, and outcomes of various surgical procedures for evacuation of intracranial abscesses in patients admitted to our Neuro-intensive care unit at R.N.T. Medical College ,Udaipur, Rajasthan, India from January 2013 to June 2019.

Results - We carried out 53 procedures in 43 (30 male and 13 female) patients with various intracranial abscesses. Most abscesses [16, i.e. 37%] occurred in the second decade and second most common in the first decade [15, i.e 34%]. In infants 4 (9%) cases of intracranial abscesses were present. None of the infants had features of congenital heart disease. The predisposing factors were mostly otolaryngologic (15) or posttraumatic (8). Most commonly abscesses were located in frontal 13 (30%) followed by cerebellar 9 (21%). Burr hole evacuation was done in 74% of cases. 3 patients (7% of cases) died. Prognosis appears to worsen with ventriculitis, multiple abscesses especially in infants, and immunosuppression.

Conclusion - In conclusion, brain abscess is a still continues to be a formidable challenge , with prognosis that dramatically improved over the last decades due to advances in brain imaging, neurosurgical techniques and better use of old and more recent antibacterial agents. Mortality is improved compared with historical series; however, long-term morbidity is significant particularly in the infant population. Further researches must be conducted to clarify specific aspects, such as anticonvulsant prophylaxis/therapy, and also for the improvement of microbiological diagnosis.

INTRODUCTION

Brain abscess is defined as a focal intracranial infection that is initiated as an area of cerebritis and evolves into a collection of pus surrounded by a vascularized capsule. Magnetic resonance imaging (MRI) is the diagnostic neuroimaging procedure of choice in patients with brain abscess [3], it is more sensitive than computed tomography (CT) and offers significant advantages in the early detection of cerebritis, more conspicuous demonstration of spread of inflammation into the ventricles and subarachnoid space, and earlier detection of satellite lesions [15].

This paper is a study of pattern and outcomes of treatments of intracranial abscesses in our institute as well as review of available literature on the subject.

MATERIALS AND METHODS

Demographic, clinical, and radiological data, treatment modalities, and outcomes were obtained from case file and radiological and operating room records. All patients had detailed neurological and systemic examination to find sources of infection. CT/MRI scan was carried out on all patients on the finding of clinical features referable to the nervous system or features of raised intracranial pressure. A hypodense mass with an encircling ring of contrast enhancement - usually associated with perilesional edema and mass effect - on brain CT/MRI confirms the diagnosis of abscess. The patients were thereafter prepared for emergency evacuation.

Laboratory investigations

Full blood count, erythrocyte sedimentation rate, serum electrolytes, urea and creatinine, blood sugar, Mantoux test, and retroviral screening were requested, if indicated, especially in recurrent abscesses and very ill patients. Otorhinolaryngologic assessment was carried out on patients with history of or ongoing sinus and ear infections. Chest radiographs were requested for all patients and children below 2 years, who were further examined with echocardiography. 43 patients underwent various surgical evacuation procedures, viz. burr hole evacuation, limited craniectomy procedures with abscess evacuation in patients with associated osteomyelitis of the skull, bedside needle aspiration via previous burr hole or cranial defect and craniotomy with decortication. The patients were commenced on broad-spectrum antibiotics: Intravenous ceftriaxone and gentamycin and, in patients with otogenic infections, metronidazole was added for 6-8 weeks, followed by 6-8 weeks of oral antibiotic treatment depending on the culture reports.

Results

43 patients underwent 53 surgical procedures for evacuation of intracranial abscesses. The ages of patients ranged from 3 months to 75 years (mean–17.5 years). There were 30 males and 13 females (M:F=2.3:1). Most intracranial abscesses occurred in

theseconddecadeoflife,accountingfor16,i.e.37%,followedby in the first decade of life i.e. 15 (34%)[Table 1]. Most common location was frontal 13(30%), followed by cerebellar 9 (21%). Mostcommonproceduredonewasburrholeevacuation.

Table1-age and sex distribution of intracranial abscesses

Age(years)	Male	Female	Total
0-1	3	1	4
2-5	7	0	7
6-10	3	1	4
11-20	11	5	16
21-30	3	1	4
31-40	3	1	4
41-50	0	2	2
51-60	0	0	0
>60	0	2	2
Ttotal	30	13	43

Predisposing factors

Thesourceoftheabscesswasunknownin13patients.Theothers were:Post-meningitic(10),otogenic(2),mastoiditis(2),sinusitis (6),posttraumatic(6)andtuberculosis(4)[Table2].

Table2–Predisposing factors

Source of infection	Total no
unknwon	13
Post-meningitic	10
otogenic	2
mastoiditis	2
sinusitis	6
posttraumatic	6
tuberculosis	4
total	43

Locationand type-

13 (30%) intracranial abscess were frontal in location. The other locations were: Parietal (6), temporal (4), fronto-parietal (1), temporo-parietal (3), parieto-occipital (6), cerebellar (9), fronto-temporal(1)[Table-3].

Hemispheric distribution-

17 were located in the right hemisphere and 26 were located in lefthemisphere[Table-4andFigures1-5].

Table3– location of abscesses

Location	No(%)
Frontal	13(30)
Parietal	6(15)
temporal	4(9)
Fronto-parietal	1(2)
Fronto-temporal	1(2)
Temporo-parietal	3(6)
Parieto-occipital	6(15)
cerebellar	9(21)
Total	43

Table4-Hemispheric distribution

Right	17
Left	26
Total	43

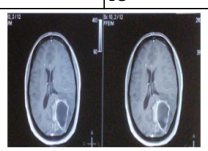

Fig 1 – T1W post contrast MRI showing ring enhancing lesion in leftparieto-occipital region.

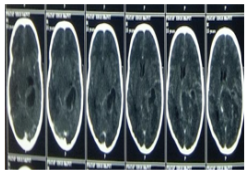

Fig 2 – post contrast CT scan showing ring enhancing lesion in leftparietal region

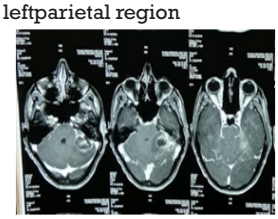

Fig 3 – T1W post contrast MRI showing ring. Enhancing lesion in left cerebellar hemisphere.

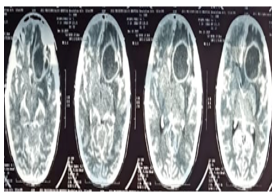

Fig 4 – post contrast CT scan showingring enhancing lesion in left frontal lobe.

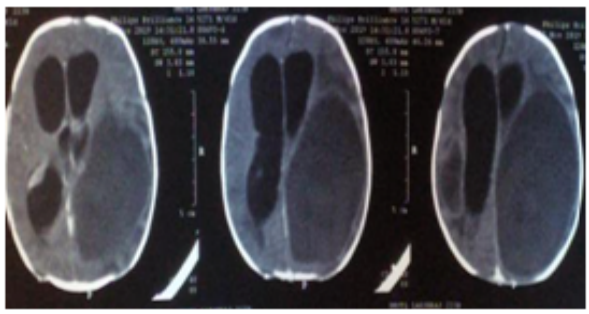

Fig5–Noncontrast CT scanin 5month old maleshowinglarge abscess in left temporo parietalregion.

Surgical treatment

Burr hole evacuation was carried out in 32 patients - frontal (14), parietal (10), temporal (6), frontal and parietal (1) [Table – 5]. Aspiration of residual abscess was repeated in 10 patients. Limited (3-6 cm diameter) craniectomy procedures with abscessevacuationwere carriedoutinpatientswithassociated osteomyelitis of the skull with or without depressed skull fracture: suboccipital craniectomy evacuation [9], frontal craniectomy evacuation with elevation of depressed fracture [2],craniectomywasperformedforallcerebellarabscess,9out of9[Table–6].Burrholeevacuationwassufficientformostofthe abscess located in cerebral hemisphere except when associated with skull osteomyelitis or fracture of skull bone.

Table5–locationofburrholes

Burrholeevacuation	no
Frontal	14
parietal	10
temporal	6
Frontalandparietal	2
total	32

Table6–limited craniectomy

Limitedcraniectomy(3-6cm)	no
Sub-occipital	9
Frontalcraniectomy	2
Total	11

DISCUSSION

Brain abscess is defined as a focal intracranial infection that is initiated as an area of cerebritis and evolves into a collection of pus surrounded by a vascularized capsule. The most common predisposing conditions in children were sinusitis, meningitis, and traumatic brain injury [21]. Organisms can reach the central nervous system (CNS) through spread from a contiguous source

ofinfection(25%to50%ofcases),hematogenousdissemination (20% to 35% of cases), or trauma [11,8,3]. It can occur at any age (averageragesfrom40to45years),withamaletofemaleratioof 2:1 in most studies [1]. Our study showed a marked male predominance in < 40 years and female predominance > 40 years, there are more patients in second decade. Sources of a contiguous focus of infection include the middle ear, mastoid cells,andparanasalsinuses.Brainabscessthatresultsfromotitis media usually localizes to the temporal lobe or cerebellum; in one review, 54% were in the temporal lobe, 44% in the cerebellum,and2%inbothlocations[18].Inpatientswithbrain abscess secondary to paranasal sinusitis, the frontal lobe is the predominant site. When the abscess is a complication of sphenoid sinusitis, the temporal lobe or sella turcica is usually involved. Dental infections, particularly of the molar teeth, can leadtobrainabscess[6,20];theseoftenoccurinthefrontallobe, buttemporallobeextensionhasbeenreported[13].

Clinicalfeatures

Headache is generally observed in 70% to 75% of patients; suddenworseningoftheheadache,accompaniedbynewonset of meningismus, may signify rupture of the abscess into the ventricular space [17]. The classic triad, fever, headache, and focal neurological deficits, is seen in less than 50% of patients with brain abscess. The specific neurological findings for brain abscessarealsodefinedbylocationwithintheCNS[7].

Diagnosis

The evolution of a brain abscess includes four stages based on histological criteria: The acute inflammatory stages, early cerebritis (days 1-3) and late cerebritis (days 4-9), early encapsulation (days 10-13), and late encapsulation (day 14 and later).Inlesionsthatwerewellencapsulated(14daysandolder), five distinct histological zones were apparent: A well-formed necrotic center; a peripheral zone of inflammatory cells, macrophages,andfibroblasts;thedensecollagenouscapsule;a layer of neovascularity associated with continuing cerebritis; and reactive astrocytes, gliosis, and cerebral edema external to the capsule [2]. The CT appearance of well-encapsulated abscesses showed a typical ring-shaped contrast-enhancing lesion. Magnetic resonance imaging (MRI) is the diagnostic neuroimaging procedure of choice in patients with brain abscess[3],itismoresensitivethancomputedtomography(CT) and offers significant advantages in the early detection of cerebritis, more conspicuous demonstration of spread of inflammation into the ventricles and subarachnoid space, and earlier detection of satellite lesions [15]. On T1-weighted images,theabscesscapsuleoftenappearsasadiscreterimthatis isointense to mildly hyperintense; administration of gadolinium–diethylenetriaminepentaaceticacidhelpsclearly differentiate the central abscess, surrounding enhancing rim, andcerebraledema.OnT2-weightedimages,thezoneofedema that surrounds the abscess demonstrates marked high signal intensity in which the capsule appears as an ill-defined hypointenserimatthemarginoftheabscess.

Management

Theinitialapproachtomanagementofapatientwithasuspected brain abscess is a multidisciplinary one that involves a neuroradiologist, neurosurgeon, and infectious disease specialist. After neuroimaging, if single or multiple ring-enhancing lesions are found, prudent management involves either aspiration or excision of lesions larger than 2.5 cm in diameter, depending on brain location. Although abscess size greaterthan2.5 cmhasbeenrecommendedasanindicatorfor neurosurgical intervention , data from comparative studies are lacking, and this size cannot be regarded as a definitive indicationforaspiration[3].Drainageshouldbeconsideredifan abscess is abutting the ventricular system, to prevent abscess rupture and resulting ventriculitis. After aspiration of abscess material and submission of specimens for special stains, histopathologic examination, and culture, empirical antimicrobial therapy should be initiated. Because antimicrobialtherapybeforeaspirationmayreducetheyieldof bacterial cultures, it is reasonable to postpone initiation of antimicrobial therapy until after neurosurgery has been performed. Delaying antimicrobial therapy should be considered only in clinically stable patients and, therefore, everyeffortshouldbemadetoperformsurgeryinanexpedited manner [3]. The combination of metronidazole plus a third-generation cephalosporin is commonly used, in patients in whom S. aureus is also considered a probable pathogen, vancomycinisaddedpendingidentificationoftheorganismand in vitro susceptibility testing .Surgical therapy is often required fortheoptimalapproachtopatientswithbacterialbrainabscess [19,5,4,12]. Procedures include bur-hole aspiration and complete excision after craniotomy, although no prospective trialcomparingthesetwoprocedureshaseverbeenperformed. However, in one retrospective review of 47 studies from 1990 to 2008,patientswhounderwentaspirationhadamortalityof6.6%, comparedwith12.7%inthosewhounderwentsurgicalexcision, asecondaspirationshouldbeconsideredifthe initialaspiration proves ineffective or partially effective. Mortality rates in patients with brain abscess in the pre-antibiotic era and into the 1970swereunacceptablyhighandrangedfrom30%to80%[11]. Since the 1970s, case fatality rates have ranged from 0% to 24%. Thisdecreasehasbeenattributedtotheintroduction(~1970s)of neuroimaging, which allows early diagnosis and monitoring of response to therapy. Although the optimal approach to brain abscess most often requires a combined medical and surgical approach, certain groups of patients may be treated with medicaltherapyalone[7,14,10].Suchgroupsincludethosewith medical conditions that increase the risk associated with surgery, with multiple abscesses, with abscesses in a deep or dominantlocation,withcoexistingmeningitisandwithabscess sizelessthan2.5 cmto3 cm.Completeexcisionbycraniotomy is now infrequently performed because of the success of aspiration and closed-drainage techniques, although it may be required for patients with multiloculated abscesses in whom aspirationtechniqueshavefailed,forabscessescontaininggas, or for abscesses that fail to resolve. Excision is usually required for posttraumatic abscesses that contain foreign bodies or retained bone fragments to prevent recurrence, for abscesses that result from fistulous communications (e.g., secondary to trauma or congenital dermal sinuses), and for those localized to one lobe of the brain and contiguous with a primary focus [4]. It hasalsobeensuggestedthatexcisionisthepreferredmethodof surgical treatment of cerebellar abscesses in children [9] given that worse outcomes have been seen in those treated only by aspiration. However, bur-hole aspiration has also been suggested as a satisfactory method of drainage in patients with cerebellarabscesses[16].

CONCLUSION

Inconclusion,brainabscessisastillcontinuestobeaformidable challenge , with prognosis that dramatically improved over the last decades due to advances in brain imaging, neurosurgical techniques and better use of old and more recent antibacterial agents. Mortality is improved compared with historical series; however, long-term morbidity is significant particularly in the infant population. Further researches must be conducted to clarify specific aspects, such as anticonvulsant prophylaxis/therapy, and also for the improvement of microbiologicaldiagnosis.

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NOTES–nopotentialconflictofinterestrelevanttothisarticlewasreported.

INFORMED CONSENT – informed consent was obtained from all individual participantsincludedinthisstudy.