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ORIGINAL ARTICLE

Anaerobic brain abscess

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ABSTRACT

Background and Objectives: Brain abscess remains a potentially fatal central nervous system (CNS) disease, especially in developing countries. Anaerobic abscess is difficult to diagnose because of cumbersome procedures associated with the isolation of anaerobes.

Materials and Methods: This is a hospital-based retrospective microbiological analysis of 430 brain abscess materials (purulent aspirates and/or tissue), for anaerobic organisms, that were received between 1987-2014, by the Microbiology Laboratory in our Institute.

Results: Culture showed growth of bacteria 116/430 (27%) of the cases of which anaerobes were isolated in 48/116 (41.1%) of the cases. *Peptostreptococcus* (51.4 %), was the predominant organism isolated in four cases followed by *Bacteroides* and *Peptococcus* species.

Conclusion: Early diagnosis and detection of these organisms would help in the appropriate management of these patients.

Keywords: Brain, Abscess, Anaerobes

INTRODUCTION

Brain abscess constitute an important cause of space occupying lesions in developing countries. The incidence of brain abscess is increasing due to the increased incidence of immunocompromised conditions. Although the source of infection is frequently apparent, the definitive cause remains obscure in 10-37 percent of patient (1). Brain abscess can develop either by a contiguous spread, hematogeneous dissemination or by direct inoculation through trauma. The bacteriology of brain abscess has changed significantly with increase of anaerobic infections (2). However, these organisms are neglected and not being routinely isolated due to the cumbersome isolation procedures. The aim of this study is to determine the incidence of anaerobic brain abscess in our institute which will help the neurosurgeon in starting appropriate treatment for the patients.

MATERIALS AND METHODS

This is a hospital-based retrospective microbiological analysis of 430 brain abscess materials (purulent aspirates and/or tissue) that were received between 1987-2014, by the Microbiology Laboratory in our Institute.

All specimens were routinely processed for aerobic, anaerobic, fungal and mycobacterial cultures. Anaerobic culture was performed on 5% sheep blood agar plates and incubated in Dyna micro Gaspak till 2004 and then in GEN bag anaerobic pouches *(bioMerieux, Marcy l'Etoile- France).* Kanamycin and a Metronidazole disc (5 µg) were placed on the secondary streak lines, to confirm the presence of an anaerobe. Isolates susceptible to metronidazole were

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considered to be anaerobes. Gram staining of such isolates was carried out to confirm the morphology and the genus. Aero tolerance test was performed to demonstrate that these isolates were obligate anaerobes. The anaerobic isolates were identified up to the genus level only.

RESULTS

Culture showed growth of bacteria in 116/430(27%) of the cases of which anaerobes were isolated in 48/116 (41.1%) of the cases. Anaerobic brain abscesses were diagnosed in all age groups, with a male preponderance (male to female ratio was 2.7:1)(Table 1). The most common site affected was the temporal lobe and chronic suppurative otitis media (CSOM) underlying risk factor in majority (36/48,75%) of the cases (Table 2). Rest of the cases include Cyanotic congenital heart diseases such as tetralogy of Fallot (TOF) in 5 patients, 4 cases of traumatic brain abscess following road traffic accident,1 case of pulmonary AV malformation, 1 post caesarian patient and 1 patient in whom the cause was unknown. *Peptostreptococcus* (51.4 %), was the predominant organism isolated followed by *Bacteroides* and *Peptococcus* species (Table 3). Mixed infections (both aerobic and anaerobic) was observed in 14 and mixed anaerobic infections in 3 cases (Table 4). All our patients had a successful outcome except one patient with TOF who succumbed.

DISCUSSION

Brain abscess are more common in developing countries, with an incidence of up to 8% (3). The etiology of brain abscess vary with time, demographic characteristics, risk factors and mode of infection (4).

There are many risk factors for the development of brain abscess and the organisms isolated depends on the mode of acquisition of the abscess. Anaerobic brain abscess are more common in cases of contiguous spread of infection from upper respiratory tract. Proper identification of causative organism and accurate antibiotic selection are essential in the management of anaerobic brain abscess (5).

Brain abscesses may affect any age group but most commonly occurs in the first two decades of life (6). The spectrum of organisms seen in brain abscess usually depends on the primary source of infection. Anaerobic brain abscess exhibit various clinical manifestations. In addition, it is difficult to isolate, identify and treat the infection caused by anaerobic organisms. Drainage of abscesses, debridement of necrotic tissues along with antibiotics are essential approaches in the treatment of these infections (7,8).

CSOM was the major predisposing factor for brain abscess in our study and was observed in 36 of our cases. Any patient with CSOM should be properly managed to prevent the incidence of brain abscess.

Table 1. Demographic data of patients with anaerobic brain abscess

S. no	Age group	No of cases (%)
1	1-10	3 (6)
2	11-20	14 (29)
3	21-30	11 (22)
4	31-40	9 (18)
5	41-50	5(10)
6	51-60	3(6)
7	61-70	3(6)

Male-35 Female-13 (Male to Female ratio was 2.7:1)

Table 2. Underlying risk factors of anaerobic brain abscess

Location	CSOM	cCHD	Trauma	Pulmonary	Miscellaneous
Cerebellar	10	-	-	-	-
Frontal	9	1	1	-	1
Temporal	12	-	1	-	-
Thalamus	-	-	-	1	-
Tempero occipital	-	-	-	-	1
Parieto occipital	-	1	-	-	-
Parietal	-	3	1	-	-
Fronto parietal	5	-	1	-	-

CSOM: chronic suppurative otitis media, cCHD: congenital cyanotic heart disease

Table 3. Anaerobic organisms isolated in brain abscess

S.no	Organism Isolated	No of isolates (%)
1	*Peptostreptococcus*	26 (54.1)
2	*Bacteroides*	18 (37.5)
3	*Peptococcus*	5 (10.4)
4	*Veillonella*	3 (6.25)
5	*Prevotellamelaninogenicus*	1(2)

Table 4. Organisms isolated from single and mixed infections

S.no	Organism isolated	No of isolates	Underlying Risk Factor
Single anaerobe			
1	*Peptostreptococcus*	18	Post caessarian-1 CSOM-14 Trauma-1 cCHD-2
2	*Bacteroides*	7	Unknown-1 CSOM-6
3	*Peptococcus*	5	Pulmonary-1 CSOM-3 cCHD-1
4	*Veillonella*	1	CSOM
Mixed anaerobes			
1	*Peptostreptococcus + Bacteroides*	2	CSOM
2	*Prevotellamelaninogenicus + Peptostreptococcus*	1	CSOM
Mixed aerobic and anaerobic isolates			
1	*Pseudomonas + Bacteroides + Peptostreptococcus*	2	CSOM
2	*Strep. pneumonia + Proteus + Bacteroides*	1	CSOM
3	*Pseudomonas +Bacteroides*	2	Trauma-1 cCHD-1
4	*S. aureus + Peptostreptococcus*	1	Trauma
5	*Proteus + Peptostreptococcus*	2	CSOM
6	*S. aureus + Bacteroides*	2	Trauma-1 CSOM-1
7	*BH Streptococci + Bacteroides*	2	cCHD-1 CSOM-1
8	*Pseudomonas +Veillonella*	1	CSOM
9	*Veillonella+ Providencia stuartii*	1	CSOM

CSOM: chronic suppurative otitis media, cCHD: congenital cyanotic heart disease

Anaerobic organisms must be considered as potential pathogens in patients with CSOM, and metronidazole should be included in an empirical antibiotic regimen in such cases (9). Otogenic infections were associated with temporal or cerebellar abscesses (10). *Bacteroides* species and Gram positive micrococci are more common in cases of mastoidectomy (11). Past history of CSOM should be taken in a case of anaerobic brain abscess as this was the major risk factor in our study and treatment for anaerobes should be initiated.

Tetralogy of Fallot was the commonest cyanotic congenital heart disease (cCHD) observed. In a study by Chakraborty et al. frontal lobe was the most common site of abscess localization followed by parietal lobe (12). The peak incidence is between 4 years and 7 years of age, although cases of brain abscess may occur in adults with cyanotic congenital heart disease (13). All our patients were adults with cCHD and our study emphasizes the risk of anaerobic brain abscess in these patients.

Peptostreptococcus and *Streptococcus* spp are mostly isolated in patients with cyanotic heart disease and right-to-left shunts (14). High dose intravenous penicillin G and chloramphenicol have been used to treat brain abscess in this setting with satisfactory outcome (15). Both aerobic and anaerobic organisms were isolated from our patients and hence there should be antibiotic coverage for both the organisms.

A significantly higher mortality has also been reported in cCHD patients during brain abscess aspirations,

attributed variously to cyanotic spells (16), and to a greater midline shift and cerebral edema (17). One patient aged 22 yers with Tetralogy of Fallot and parietooccipital abscess succumbed as he developed hemorrhage in abscess cavity post operatively with midline shift. Most patients die of post operative complications rather than the disease itself and hence they should be closely followed up.

Traumatic brain abscess was observed in four of our patients in which there was mixed growth of aerobic and anaerobic organisms. In trauma, introduction of micro-organisms into cerebral tissues, implanted foreign bodies or bone chips as a result of trauma, results in brain abscess (18). In the case of trauma the aerobic Gram-positive cocci are common, but aerobic Gram-negative rods *(Klebsiella, Pseudomonas, Escherichia coli, Proteus)* may also be found (14).

Pulmonary arterio-venous shunt may contribute to the development of a brain abscess by allowing easy bacterial access to systemic circulation through the right-to-left pulmonary vascular shunt, by passing the filtering effect of the pulmonary capillaries (19). In our study one patient had undergone surgery for AV malformation of lung but developed brain abscess later with growth of *Peptococcus* spp.

In the miscellaneous group one female patient aged 22 years with complaints of headache, vomiting, seizures was diagnosed with left tempero - occipital abscess. She delivered a baby by caesarian section 2 weeks back. Lt temporal craniotomy with drainage of pus showed growth of *Peptostreptococcus* spp. She was discharged in stable condition. In the other patient the cause was unknown.

The treatment modalities include radiological diagnosis, surgical intervention, use of antibiotics, and eradication of primary infected foci (20). Antibiotics are the first-line treatment for brain abscess. High-dose, broad-spectrum, intravenous antibiotics should be administered as early as possible. Duration of antimicrobial therapy should be determined based on the size of abscess, combination of surgical treatment, causative organism, and response to treatment (2). Antibiotics can be given for a period of 4-6 weeks if combined with surgery or 6-8 weeks if only medical treatment is given (21). The common anaerobes isolated include *Bacteroides, Peptostreptococcus,* and *Fusobactrium* which are sensitive to metronidazole.

All the cases in our study received an intravenous dose of broad spectrum antibiotics empirically and treatment was narrowed based on culture reports. Metronidazole/ornidazole was continued for the patients after culture report of anaerobic organisms. Our patients had a successful outcome after treatment except one who succumbed due to post-operative complications.

CONCLUSION

Intracranial abscesses are life-threatening infections that pose a diagnostic challenge not only to the neurosurgeon but also to the microbiologists (22). Early diagnosis, appropriate management along with surgery and broad spectrum antibiotics including metronidazole will help in reducing the morbidity and mortality of the patients. Anaerobic brain abscess is not uncommon and should always be considered while treating a brain abscess. A high degree of suspicion, proper microbiological techniques for isolation of organisms and the underlying risk factor would help in the management of these patients. Proper microbiological techniques would be helpful in isolation of organisms particularly anaerobes which is more often neglected. The GEN bag anaerobic pouches are which we used are technically simple, very convenient to use and can be easily adapted by any routine microbiology laboratory for the isolation of anaerobes.

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