Microbiology of cerebral abscess at the Neurosurgical Unit of the National Hospital of Sri Lanka

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(Index words: Culture, identification of isolates, antibiotic sensitivity)

Abstract

Objectives To determine the microbial pathogens responsible for cerebral abscess, ascertain the most suitable antibiotic for treatment and to determine the predisposing causes of cerebral abscess.

Design Prospective study with microbiological investigation of pus aspirated from cerebral abscesses.

Setting Neurosurgical Unit, National Hospital of Sri Lanka, Colombo.

Study group 41 patients with cerebral abscess.

Period of study 18 months (May 1997 to December 1998)

Results Of the 41 samples of pus 26 (63.1%) gave a positive microbial culture. The Gram stain of the direct smear was positive in 77% of the 26 positive cultures. The most frequently occurring species were *Streptococcus milleri* group (35%) followed by *Staphylococcus aureus* (10%). Anaerobes accounted for 23% of positive cultures. All *Streptococcus milleri* isolates were penicillin and cefotaxime, and all anaerobic isolates except one were susceptible to sensitive to metronidazole. 75% of Gram negative bacilli isolated were sensitive to cefotaxime. All *Staphylococcus aureus* isolates were methicillin resistant, but sensitive to vancomycin and chloramphenicol.

Common predisposing conditions were congenital heart disease (30%), trauma (25%), middle ear disease (7%), and meningitis (7%).

Conclusions Organisms of the *Streptococcus milleri* group were most frequently found in cerebral abscesses. The present empirical therapeutic regime adopted in the unit which consisted of cefotaxime 1g intravenously three times daily and metronidazole 500 mg intravenously three times daily was found to be satisfactory as a majority of the organisms isolated were sensitive to these antimicrobials. In the case of methicillin resistant *Staphylococcus aureus* (MRSA), it is recommended that chloramphenicol be added to the current regime in management until the antibiotic sensitivity pattern is available.

Introduction

Cerebral abscess is a life-threatening infection. Although mortality was significantly reduced after the advent of antibiotics it still remained between 30% and 50% in the mid-1980s (1). More recently mortality ranging from 0% to 24% has been reported (2). This is attributed to the introduction of CT scanning. Although many reports have been published on surgery and treatment of cerebral abscess only a few have included

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microbiological findings. Two studies which dealt exclusively on microbiology (3,4) reported 48 and 35 cases respectively. Few published data are available from developing countries. As no such studies have been published in Sri Lanka it was decided to carry out this study.

Methods

The study group included 41 consecutive patients with brain abscess from the neurosurgical unit (wards 12 and 64) of the National Hospital of Sri Lanka. A detailed clinical history of each patient was obtained through a questionnaire. The study was conducted for a period of 18 months.

Pus samples were collected during surgery into anaerobic transport containers and transported to the laboratory as early as possible. Samples collected during normal working hours were transported within 24 hours to the laboratory.

Macroscopic appearance of the samples was noted. A wet mount and a Gram stain of a pus sample were examined microscopically. The pus samples were cultured both aerobically and anaerobically. Aerobic cultures were carried out in blood agar and MacConkey agar and incubated at 37°C overnight. Samples were plated on blood agar and chocolate agar and incubated in a candle jar for 48 hours at 37°C.

Anaerobic cultures were carried out on brucella blood agar (with haemin and vitamin K) and bacteroides bile aesculin agar. They were incubated in an anaerobic jar with an anaerobic gas pack and catalyst for 48 to 72 hours and sometimes longer.

The pus was inoculated also into cooked meat medium as a back-up culture. The cooked meat culture was incubated for 48 hours and plated on the same media and incubated anaerobically.

Aerobes were identified by conventional biochemical tests (6). The *Streptococcus milleri* isolates were identified by the following tests: (a) Gram stain and culture characteristics, (b) catalase test, (c) bacitracin and optochin disc sensitivity testing, (d) Voges-Proskauer (V-P) test and

(e) arginine hydrolysis. Anaerobes were identified by (a) aerotolerance testing (b) Gram stain and colony morphology, and (c) rapid identification methods (Rapid ANA test kits, Innovative Diagnostic Systems Ltd.) Antibiotic susceptibility testing was performed using the Joan Stokes method (7). In the case of strict anaerobes metronidazole sensitivity was checked by observing for inhibition of growth around a 5 µg metronidazole disc.

Results

Of the 41 samples analysed 26 (63%) gave a positive culture. Gram stain positivity of the direct smear was seen in 20 of the 26 positive cultures. Of the 26 positive cultures 20 showed a pure culture and 6 gave a mixed growth. The organisms isolated are shown in Table 1.

Table 1. Bacteria isolated from cerebral abscess

Organism	Number of isolates
Aerobes	
<i>Streptococcus milleri</i> group	12
<i>Staphylococcus aureus</i>	4
Coagulase negative Staphylococci	1
<i>Enterococcus avium</i>	1
<i>Pseudomonas</i> species	2
<i>Acinetobacter</i> species	2
<i>Klebsiella</i> species	2
<i>Proteus</i> species	2
Diphtheroids	1
Obligatory anaerobes	
<i>Bacteroides</i> species	2
<i>Fusobacterium nucleatum</i>	2
<i>Capnocytophaga</i> species	1
<i>Peptostreptococcus micros</i>	2
<i>Actinomyces odontolyticus</i>	1
Total	35

Table 2. Percentage sensitivity of isolates to antibiotics tested

Isolates	No. of Isolates	Pen	Cef.	Chlo.	Amp.	Met.	Carb.	Van.	Ceft
<i>S. milleri</i> gp	12	100	100	-	-	-	-	-	-
<i>Enterococcus</i> sp.	1	100	100	-	-	-	-	-	-
<i>S. aureus</i>	4	0	0	75	-	0	-	100	-
<i>Proteus</i> sp.	2	-	100	100	100	-	-	-	-
<i>Klebsiella</i> sp.	2	-	100	0	-	-	-	-	-
<i>Pseudomonas</i> sp.	2	-	0	100	0	-	100	-	100
<i>Acinetobacter</i> sp.	2	-	100	0	50	-	-	-	-

Pen. - penicillin
Amp. - ampicillin
Van. - vancomycin

Cef. - cefotaxime
Met. - methicillin
Ceft. - ceftazidime

Chlo. - chloramphenicol
Carb. - carbenicillin

Streptococcus milleri group (35%) was the most frequently occurring isolate followed by *Staphylococcus aureus* (10%). Gram negative enteric bacilli (*Klebsiella* and *Proteus* species) and the non-fermenters (*Pseudomonas* and *Acinetobacter* species) gave an isolation rate of 15% each. Obligatory anaerobes accounted for 23% of isolates.

All *S. Milleri* group isolates (100%) were sensitive to penicillin and cefotaxime. All *S. aureus* isolates were methicillin resistant and sensitive to vancomycin. Three of the four isolates of methicillin resistant *Staphylococcus aureus* were sensitive to chloramphenicol. 75% of the Gram-negative bacilli were sensitive to metronidazole.

Congenital heart disease (30%) was the commonest predisposing factor followed by trauma (25%), chronic ear disease (7%) and meningitis (7%). Three out of 4 patients who had an infection due to *S. aureus* gave a history of trauma.

There is a definite correlation between the infective organisms and the site of abscess. An attempt was made to find such a relationship in the study (3). However, correlation between the site of abscess and the organisms isolated could not be demonstrated. The sites of abscesses were frontal lobe (4), parietal lobe (9), posterior fossa (7), occipital lobe (7), temporal lobe (3), multiple abscesses (3), subdural empyema (3) and site unknown (5).

Discussion

Early diagnosis and immediate treatment is of utmost importance in the management of cerebral abscess. Early intervention by drainage and administration of antimicrobial agents will reduce morbidity and mortality. A spectrum of microorganisms is implicated in the aetiology depending on the source of infection and predisposing conditions. In this study the most frequently occurring isolates were those belonging to the *S. milleri* group. These findings corresponded to those reported by De Louvois (4) and Sabiha (5). The next common isolate was *S. aureus* and all 4 isolates were methicillin resistant. The relatively low anaerobic isolation rate could be attributed to the fact that metronidazole and cefotaxime were given empirically to all patients with cerebral abscess following admission to the ward, and due to a delay in transport of specimens from the hospital to the laboratory.

The common predisposing factors of cerebral abscess were found to be congenital heart disease (30%), followed by trauma (25%), middle ear disease (7%). In keeping with de Louvois' study it was shown that 3 out of 4 cases of *S. aureus* infection gave a history of surgical or accidental trauma. Although de Louvois (4) had shown a correlation with the site of abscess and the organism isolated no such relationship could be demonstrated on our study.

In choosing an antibiotic for treatment of cerebral abscess, two factors have to be taken into consideration; namely (1) the penetrating power of the drug into the central nervous system (CNS) and (2) the spectrum of antimicrobial activity of the agent. The therapeutic regime adopted in the Neurosurgical Unit was empiric therapy with cefotaxime 1 g and metronidazole 500 mg given three times a day intravenously during their stay in the ward. The patient was discharged on oral penicillin 500 mg and chloramphenicol 500 mg given three times a day for one month. All these antimicrobials penetrate well into the CNS especially when the meninges are inflamed (2,4,8). The result of the antibiotic susceptibility test showed that all (100%) streptococci and 75% of Gram negative bacilli were sensitive to cefotaxime, and all anaerobic isolates except the anaerobic cocci were sensitive to metronidazole.

The only exception was methicillin resistant *Staphylococcus aureus*. In such cases vancomycin would be the drug of choice (2). The disadvantage of vancomycin is that the penetration of the drug into the brain is poor (8). The alternative would be chloramphenicol, as 3 out of 4 MRSA isolates were sensitive to the drug, and penetration of the drug into CSF is excellent. Therefore, it is recommended that chloramphenicol be added as the third drug in empiric therapy especially in cases with a history of surgical or accidental trauma.

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