

# Common bacteria isolated from brain abscesses

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## ABSTRACT

**Objectives:** This study was conducted to ascertain the common bacteria causing brain abscesses in patients admitted to the Neurosurgical Department at Khoula Hospital under the Ministry of Health, Sultanate of Oman. This is the only center that provides neurosurgical services in the Sultanate of Oman. The obtained data were further analyzed to find out what factors predisposed to abscess formation in these patients.

**Methods:** A retrospective study of cases of brain abscess from whom samples were received in the microbiology section of the laboratory of Khoula Hospital over the period January 1999 to December 2000 was carried out. The microbiology laboratory records and the patient's medical records were reviewed to collect the data.

**Results:** Thirteen patients were identified with a diagnosis of brain abscess. *Streptococci* were the

predominant organism accounting for 53.8% followed by *Staphylococcus aureus* (26.7%). Other organisms were *Bacteroid* and *Nocardia* species. The most common associated condition found was otitis media; others in order being sinusitis and meningitis.

**Conclusion:** Brain abscesses are potentially life-threatening lesions that require immediate intervention. Knowledge of the etiologic agent allows targeted antimicrobial therapy which will be life saving as observed in our series. Our results indicate that the incidence is still high among children and adolescents. Parental/public awareness of the importance of prompt treatment of infections such as otitis media, sinusitis, and so forth, can lower the incidence of this disease.

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**B**rain abscess is a focal, intracerebral infection that begins as a localized area of cerebritis and develops into a collection of pus surrounded by a well-vascularized capsule.<sup>1</sup> They are relatively uncommon. It has been estimated that they account for approximately 1 in 10,000 general hospital admissions. Brain abscesses develop in 4 clinical settings; associated with a contiguous infection (for example, infection arising from the paranasal sinuses, middle ear and teeth), after hematogenous spread from a distant focus, after trauma and finally 20% of the cases will be identified as cryptogenic where no primary focus is recognized.<sup>2</sup> The etiology of brain abscess can be bacterial, fungal or parasitic. They are frequently polymicrobial, and the common etiologic organisms in clinical series have been microaerophilic *Streptococci* and anaerobic bacteria.<sup>3</sup> Additional organisms such as

*Staphylococcus aureus* (*S. aureus*), *Enterobacteriaceae*, *Nocardia* and *Listeria monocytogenes* are also seen. Yeast and fungi have been implicated as the cause of 1-17% of cases and parasites account for less than 1% of brain abscess. Diagnosis of clinically suspected brain abscess is aided by imaging studies such as CT or MRI scanning. Stereotactic needle aspiration permits therapeutic drainage and provides diagnostic specimens for culture. Careful culturing of abscess material provides the best opportunity to make a microbiological diagnosis.<sup>1</sup> Empirical antimicrobial therapy can be started on the basis of Gram stain results and the presumptive source of the abscess. We planned a retrospective study of cases of brain abscess as observed in the microbiology section of the laboratory at Khoula Hospital, as it is the only center providing neurosurgical services in the

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Sultanate of Oman. The aim of this study is to ascertain the common bacteria causing brain abscess in our center, as well as the factors that predispose to abscess formation in these cases.

**Methods.** Microbiology laboratory records were reviewed for the period January 1999 to December 2000 to ascertain the number of cases of brain abscess from whom aspirated abscess material was sent to the laboratory for culture during the 2-year period of study. Also, the medical records of these cases were reviewed to collect the following data on each case: age, sex, clinical condition of the patient on admission, risk factors for brain abscess, treatment received and the outcome of treatment. The collected data were then analyzed.

**Results.** During the period under study, the microbiology laboratory at Khoula Hospital received a total of 24 pus samples aspirated from brain abscesses. Out of these, 10 samples were culture positive, 3 were positive by Gram-staining only and the remaining 11 samples were negative by both culture and Gram-stain. Only those with positive culture and positive Gram-stain were involved in this study (13 cases in total). Out of these 13 cases, 9 were males and 4 females. The age groups involved in our case study are shown in **Table 1**. The predominant group was 2nd decade, which accounted for 38.5% of the total. The common etiological organisms for brain abscesses, which were isolated by culture, found in this study were as follows: *S. aureus* (4 cases), *Streptococcal* species (aerobic and anaerobic 4 cases). *Bacteroid* species in one case and *Nocardia* species in one case. In addition to these, some organisms were seen only on Gram-stained smears and these were: Gram positive cocci arranged in pairs and chains seen in one case and Gram positive cocci arranged in chains mixed with Gram negative bacilli seen in 2 cases, this makes the total number of *Streptococcal* species causing brain abscesses in this study to be 7. From this study, it was found that the most common condition associated with brain abscess was otitis media where it accounted for 23% of cases. This was followed by sinusitis and meningitis (15% each). Other associated conditions found were congenital heart disease, head trauma, mastoiditis and immunodeficiency and each accounted for 8% (**Table 2**). In 15%, the cause was not known (cryptogenic). The type of isolated organism in relation to the predisposing conditions as found in this study are shown in **Table 3**. All cases involved in the present study were treated surgically (either excision or aspiration) plus antimicrobial therapy. The antibiotics were modified according to the sensitivity of the isolated organism. Eleven patients of the involved cases made a good recovery with the

**Table 1** - Number and percentage of patients with brain abscess in different age-groups.

Age Group	n (%)
< 1 year	1 (7.7)
1-10 years	1 (7.7)
11-20 years	5 (38.4)
21-30 years	2 (15.4)
31-40 years	1 (7.7)
41-50 years	2 (15.4)
51-60 years	1 (7.7)
<b>Total</b>	<b>13 (100)</b>

**Table 2** - Number and percentage of patients with conditions associated or predisposed to brain abscess formation.

Condition associated	n (%)
Otitis media	3 (23)
Sinusitis	2 (15)
Meningitis	2 (15)
Congenital heart disease	1 (8)
Cryptogenic	2 (15)
Mastoiditis	1 (8)
Head trauma	1 (8)
Immunodeficiency (HIV)	1 (8)

**Table 3** - Type of organism isolated in relation to the predisposing conditions.

Condition	Organism isolated
Otitis media	<i>Streptococci, S. aureus, Bacteroid</i>
Sinusitis	<i>S. aureus, Streptococci</i>
Head trauma	<i>S. aureus</i>
Immunodeficiency (HIV)	<i>Nocardia species</i>
Meningitis	<i>S. aureus, Bacteroid</i>
Congenital heart disease	<i>Streptococci</i>
<i>S. aureus - Staphylococcus aureus</i>	

above treatment whereas 2 patients expired despite the treatment.

**Discussion.** Brain abscess is a rare disease, 4-10 cases are seen yearly in active neurosurgical services.<sup>4-6</sup> A similar finding is observed in this study where approximately 12 cases are seen yearly. Our study showed a male predominance (2.25:1) among patients with brain abscesses, which is consistent with that reported by other authors.<sup>2</sup> The predominant age group found in our study was 11-20 years. This differs from that in the literature where the age group 30-40 years is the most commonly involved one.<sup>2</sup> However, the predominant age may vary with etiology. Brain abscess due to otitis media more commonly occurs in the pediatric age group (less than 15 years) and after 40 years of age, whereas those due to paranasal

sinusitis more commonly occur between 10 and 30 years of age.<sup>7,8</sup> The most common organisms isolated from brain abscess are various strains of *Streptococci* that account for approximately 60-70% of all brain abscess formation.<sup>2</sup> Similarly, *Streptococci* was the predominant organism reported in our study as it accounted for 53.8% of all organisms isolated by culture and those seen on Gram-stain only. *Staphylococcus aureus* was the second most common organism reported in our study where it accounted for 26.7% of the reported organisms. This differs from that reported by others where only 10-15% were *Staphylococcus* positive and mainly in trauma related and post-surgical infections. In 2 of our patients, *S. Aureus* brain abscesses occurred following meningitis and in one case following head trauma. Multiple organisms, usually mixed aerobes and anaerobes are seen in 30-60% of cases.<sup>1</sup> Polymicrobial infection was reported in 2 cases in the present study on the basis of Gram-stain results but the organisms failed to grow on culture. This could be due either to prior antibiotic treatment or delay in transport and processing of the specimens. Cerebral nocardiosis is frequently seen in patients with immunodeficiency. This is consistent with our finding where *Nocardia* species was reported from a patient with HIV infection. The common primary foci of brain abscess are infections arising from paranasal sinuses, middle ear and teeth, and 40-60% of brain abscesses are associated with these conditions and this observation tallies with our results (48%).<sup>2</sup> However, recent reports have showed decrease in the incidence of these conditions as a result of improvement in their therapy.<sup>9,10</sup> In our study the most common associated condition was otitis media followed by sinusitis and meningitis. Cyanotic congenital heart disease (CCHD) is a significant predisposing factor for brain abscess in children and accounts for 6-50% of cases in published series.<sup>1</sup> The most common organisms isolated are *Streptococci* (microaerophilic and anaerobic) and occasional *Haemophilus* species.<sup>1</sup> In the present study, *Streptococci* was isolated from the single case of CCHD.

The most successful predictor of clinical outcome for patients with brain abscess is the extent of neurological compromise at the time of

presentation and diagnosis.<sup>1</sup> The 2 deaths among our cases were mainly due to rapidly progressing neurological impairment.

In conclusion, brain abscesses are potentially life-threatening lesions that require immediate intervention. Careful attempts to obtain materials for culture, proper handling of the specimens and prompt plating on appropriate culture media are important. Knowledge of the etiologic agent allows targeted antimicrobial therapy which will be life saving. Our results indicate that the incidence is still high among children and adolescents. Parental/public awareness of importance of prompt treatment of infection such as otitis media, sinusitis, and so forth, can lower the incidence of this disease. Finally, prompt treatment of the focus of the primary infection can also lower the incidence of brain abscesses.

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