STAPHYLOCOCCAL BRAIN ABSCESES: A REVIEW

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ABSTRACT

Brain abscesses induced by *Staphylococcus aureus*, a pathogenic bacterium, differed from those generated by less virulent species in both quantity and quality. Larger lesions were produced by *S. aureus* abscesses because they caused early ependymitis, slowed the healing process, and affected sites where inflammation leaked outside the collagen capsule. Similar results from imaging tests indicated that the abscesses were bigger, had more central necrosis, and had earlier signs of ependymitis. This virulent bacterium also showed that white matter is more vulnerable to infection-induced damage than gray matter that covers it. The histologic findings and the pattern of distribution indicate that the development of collagen capsules serves a less effective "containment" role for infections than *Staphylococcus aureus* did in the past. When they are admitted, about 20% of patients exhibit all three symptoms (fever, focal neurological impairment, and headache). Before starting any antibiotics, at least one lesion should be stereotactically suctioned during brain imaging utilizing contrast-preferential magnetic resonance imaging, which is the gold standard for diagnosis. The proper handling of brain abscess samples is crucial for correct reporting of microbiological findings. It is best to approach phytoplankton empirically. Since brain abscesses are frequently polymicrobial, de-escalation based on microbiological findings is safe only when aspiration samples have been processed as well as possible or when endocarditis is the prevalent diagnosis. In the majority of cases, a 6-week regimen consisting of metro-nidazole and third-generation cephalosporins will cure *Staphyloccocal* brain abscesses obtained in the community.

INTRODUCTION

An intracerebral collection of pus is called a brain abscess. Headache, fatigue, fever, and localized neurologic impairments are possible symptoms. With contrast-enhanced MRI or CT, a diagnosis is made. Antibiotics are used in combination with surgical drainage or CT-guided stereotactic aspiration as a standard treatment. An intraparenchymal pus collection is known as a brain abscess. In underdeveloped nations, brain abscesses account for about 8% of intracranial masses, whereas in developed nations, they account for 1% to 2% [1, 2]. They develop into collections of pus encased in a highly vascularized capsule from localized regions of cerebritis in the parenchyma. Bacterial brain abscesses can be lethal despite significant advancements in neuroimaging, neurosurgery, neuroanesthesia, microbiological isolation methods, and antibiotic therapy [3-6]. Different rates of death are caused by variations in the epidemiology and clinical spectrum of brain abscesses, as well as by predisposing factors and the prevalence of involved bacterial infections.

Abscesses in the brain are often rare. *Staphylococci*, kind of gram-positive bacteria (GBP), are responsible for the majority of brain abscesses. A genus of Gram-positive bacteria belonging to the Bacillales order's *Staphylococcaseae* family is called *Staphylococcus*. They develop in clusters that resemble grapes and appear spherical (cocci) under a microscope. Species of *Staphyloccocus* are facultative anaerobics, meaning they can grow both aerobically and anaerobically. *Staphylococcus aureus* is a human pathogen in addition to a commensal bacterium. *S. aureus* is present in about 30% of the human population. In addition, it is a primary cause of brain abscess, osteoarticular, skin and soft tissue, pleuropulmonary, and device-related infections in addition to bacteremia and infective endocarditis (IE). This bacterium is frequently the source of infections in both hospital and community settings. The rise of multi-drug resistant bacteria, like MRSA (Methicillin-Resistant *Staphylococcus aureus*), makes treatment difficult. On healthy skin, *S. aureus* often does not cause illness; but, if it gets into the bloodstream or internal tissues, it can cause a number of potentially dangerous diseases [7].

Brain abscesses are thought to have a 20% mortality rate in developed nations [8]. Because CT and MR imaging techniques are more effective at identifying and localizing brain lesions, mortality has decreased [9-11]. However, malignant tumor abscesses, particularly those from glioblastoma multiforme (GBM), are not usually reliably demonstrated by them [12-15]. Necrotic or cystic tumors and brain abscesses typically exhibit perilesional contrast enhancement with gadolinium chelates, hypo-intensity on T1-weighted MR images, and hyperintensity on T2-weighted MR imaging. It looked promising to employ diffusion-weighted MR images, which often exhibit lower apparent diffusion coefficients for abscesses than for GBM [16, 17].
Subdivision of MR spectra from abscesses based on certain causes (tuberculosis, anaerobic bacterial abscesses, and other abscesses) was shown to be possible in a recent work [18]. Nonetheless, patterns found in abscesses brought on by microaerophilic bacteria and GBMs were comparable. Operator-based analysis was unable to make a differentiation for these abscesses. 10% to 31% of brain abscesses are caused by S. aureus [19–22]. Since S. aureus typically progresses quickly to the clinical stage, antimicrobial medications may not be part of empirical antimicrobial therapy, early detection of the infection is crucial. Based on available data, it is not feasible to quickly identify this particular subset of abscesses using in vivo magnetic resonance spectroscopy. Multivariate analysis and pattern recognition algorithms are more sensitive than operator-based analysis of spectrum features [23–26]. A statistical classification approach (SCS) was developed to diagnose cancer, organ rejection, and microbial pathogen speciation by analyzing complex spectra [27–28]. Using a rat animal model, we aimed to assess the feasibility of SCS for MR spectra in distinguishing between GBM and microaerophilic bacterial abscesses. We also attempted to determine the metabolites of bacterial and host origins that would be implicated in the most discriminatory regions in the MR spectra of brain abscesses as well as the most recent methods of diagnosis and therapy.

**PATHOGENESIS**

A focused infection of the brain, a brain abscess starts as a small area of cerebritis and grows into a mass of pus encased in a well-vascularized capsule [29]. The time course of untreated streptococcal brain abscesses was estimated using a groundbreaking experimental model that combined systematic histology and computed tomography (CT) studies in dogs. The results showed that the abscesses developed into early cerebritis (days 1-3), late cerebritis (days 4-9), early capsule formation (days 10-13), and late capsule formation (after day 14) [30]. Five distinct histological zones were visible in lesions that were well encapsulated (14 days and older): (a) a well-formed necrotic center; (b) a peripheral zone of inflammatory cells, macrophages, and fibroblasts; (c) the dense collagenous capsule; (d) a layer of neovascularization linked to ongoing cerebritis; and (e) astroglosis and cerebral oedema outside the capsule. Additional groundbreaking research on animals has provided important insights into pathogenesis. First, once the blood–brain barrier is breached, the brain is extremely vulnerable to bacterial infections. In fact, injections of 10⁵ CFUs of Escherichia coli or 10⁴ CFUs of Staphylococcus aureus did not cause any harm to skin tissues, while 10⁶ CFUs of the same bacteria were enough to cause an abscess in brain tissues [31]. Second, synergistic infectivity of strict anaerobes and other bacteria is an important element in pathogenesis, even though strict anaerobes or microaerophilic bacteria were unable to create brain abscesses in a rat model [32]. Third, in contrast to the cortical surface of a brain abscess, the capsule is typically less robust on the ventricular surface. This could be the result of variations in the vascularization of the white and grey matter, which would also explain why a brain abscess typically ruptures into the ventricular system, which can have serious repercussions, as opposed to the subarachnoid space.

**SYMPTOMS**

**Symptoms**

Symptoms of a staphylococcal brain abscess in patients may consist of:

- **Headache**: Although it is one of the most frequent medical complaints, headaches are the most prevalent sign of a brain abscess, occurring in 69% of cases. A sudden deterioration in the headache combined with a recent development of meningismus could indicate an abscess rupture into the ventricular space.

- **Neck stiffness**: 15% of individuals who have a brain abscess experience neck stiffness. The most prevalent causes of this symptom are abscesses in the occipital lobe or abscesses that have seeped into the lateral ventricle.

**DIAGNOSIS**

**MODIFICATION IN MENTAL STATE:**

Modifications in mental state, such as lethargy leading to coma, are a poor prognostic indicator of severe cerebral edema.

**Vomiting:** Generally speaking, vomiting occurs in response to elevated intracranial pressure [33].

Just 20% of patients with brain abscesses on admission have the traditional triad of headache, fever, and localized neurological symptoms, while 69% of patients report having a headache, 53% has a fever, and 48% have a localized neurological dysfunction [9, 34, 35]. Additional typical neurological symptoms include altered consciousness (43%) and seizures (25%). Before a diagnosis, symptoms typically persisted for 8.3 days on average. A thorough clinical examination can be used to assess the location of a brain abscess, which affects the neurological presentation. However, significant differences between imaging investigations and clinical results are not uncommon. Clinicians should order urgent brain imaging in patients with brain abscesses if meningeal signs suddenly appear and worsen, along with a worsening headache and neurological status. This will rule out the possibility of an abscess rupturing into the ventricular system, which carries a 50–85% lethality rate and a high risk of obstructive hydrocephalus [36].

**CONCLUSION**

In conclusion, the prognosis for staphylococcal brain abscesses has significantly improved over the past few decades as a result of advancements in brain imaging, the use of antibiotics, and improved application of both traditional and novel antibacterial agents against staphylococcus bacteria. In 2017, the cure rate should be greater than 90% if basic management guidelines are followed and the diagnosis is discovered ‘in time’.

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**CONFLICT OF INTEREST**

All authors declare that there are no conflicts of interest.

**DATA AVAILABILITY STATEMENT**

No data was used for the research described in the article.

**AUTHOR’S CONTRIBUTION**

Rajen Dey (RD) participated in the conception of the study. Ankita Ballav (AB) participated in literature searches and extraction. AB wrote the manuscript and RD approved the final version for submission to this journal.

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