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(REVIEW ARTICLE)

Neuromelioidosis In Dental Practice: Diagnostic Challenges and Preventive Strategies A review

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Abstract

Melioidosis is an infectious disease which is most commonly found in endemic region. Its neurological form neuromelioidosis is uncommon. It mostly presents as brainstem encephalitis, meningitis, cerebral abscesses, or cranial nerve palsy. Few health care associated melioidosis outbreaks have been documented by using contaminated instruments and equipment. The most unexpected health care associated outbreak was documented in a dental clinic located in Tamil Nadu due to unsafe use of the saline bottle opened with a unsterile periosteal elevator during a dental procedure. Hence this review summarizes clinical and microbiological features associated with this condition and explain preventive and management measures of neuromeliodosis to enhance management protocols.

Keywords: *Burkholderia Pseudomallei*; Saline Bottle; Mononuclear Pleocytosis; Microabscesses; Endemic Regions

1. Introduction

Melioidosis is an infectious disease caused by the environmental Gram-negative bacterium *Burkholderia pseudomallei*[1]. It is most commonly found in tropical nations' soil and water[2]. Melioidosis is mostly considered as an opportunistic disease, affecting individuals with weakened immune systems due to medical conditions like diabetes, renal, and liver failure [3]. Although melioidosis usually presents as pneumonia or septicemia, its neurological form, neuromelioidosis, is uncommon [4]. The condition pathologically entails the invasion of the central nervous system (CNS) by hematogenous spread or direct neural transmission. It may present as brainstem encephalitis, meningitis, cerebral abscesses, or cranial nerve palsy [5]. Few healthcare-associated melioidosis outbreaks have been documented, with most linked to contaminated medical equipment, hospital environments, or injectable substances [6]. One of the most unexpected and serious healthcare-associated illnesses ever documented in India was the neuromelioidosis outbreak in the dental clinic located in Tamil Nadu. The unsafe re-utilization of a saline bottle, which had been opened with an unsterile periosteal elevator, facilitated the direct entry of *B. pseudomallei* into oral nerve pathways, resulting in complications during dental treatments [7].The purpose of this review is to summarize clinical and microbiological features associated with this condition and explain preventive and management measures of neuromeliodosis to enhance management protocols.

2. Materials and Methods

A literature-based review focussing on the outbreak of neuromeliodosis and its preventive protocols data was collected from biomedical databases like PubMed, Web of Science, Embase, and Google Scholar articles included were case

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reports, review articles and outbreak investigation upto November 2025. Articles with animal trials and studies which is not focussing on CNS melioidosis were not included.

3. Results and Discussion

3.1. Microorganism

Burkholderia pseudomallei is a Gram-negative, motile, aerobic bacillus characterized by bipolar ("safety-pin") staining. It is a saprophytic bacterium that lives in soil and water and is mostly found in the tropics and subtropics, especially in Southeast Asia, Northern Australia, and South Asia. [8,9] Humans can become infected with the bacterium through inhalation, ingestion, or inoculation of contaminated air, water, or soil. Once inside the human host, *B. pseudomallei* can disseminate hematogenously or via direct extension from adjacent structures to the CNS. Rarely, direct spread from cranial bone defects has been reported. The ability of the organism to infiltrate neural pathways facilitates axonal spread, effectively bypassing the blood-brain barrier [5].

3.2. Etiology

The principal routes of infection include Percutaneous inoculation through skin abrasions, inhalation of contaminated dust or water droplets, ingestion of contaminated water.Iatrogenic spread during dental procedures become a risk factor when contaminated instruments, saline or other solutions are used, directly introducing *B. pseudomallei* near cranial nerves and oral mucosa [7]. Medical and dental conditions can either independently or synergistically contribute to neuromelioidosis; thus, strict prevention measures and heightened vigilance is warranted in the medical and dental settings.

3.3. Prevalance

Neuromelioidosis represents approximately 3–5% of all melioidosis cases, categorizing it as an uncommon manifestation of *B. pseudomallei* infection.CNS involvement is less frequent than pulmonary or septicemic presentations, but when present, is associated with significantly higher morbidity and mortality (mortality often exceeds 25% for CNS involvement) [8]. The endemic areas, particularly in Southeast Asia and northern Australia, exhibit a greater medical prevalence attributed to significant environmental exposure to *Burkholderia pseudomallei* through soil and water [10].

3.4. Risk Factors

Diabetes mellitus is by far the most common risk factor contributing to the relatively high number of cases of neuromelioidosis. Individuals with diabetes present with an increased susceptibility because of impaired innate immunity. Chronic renal disease, chronic lung disease, and cirrhotic liver disease all increase risk substantially, presumably due to impaired host defense as well as confounding conditions of systemic illness. Immunosuppression resulting from steroid treatment, chemotherapy, or HIV/AIDS elevated the risk of initial infection as well as severe manifestations of the infection in the central nervous system[10]. *Burkholderia pseudomallei* is commonly encountered in rural areas and agricultural practices within endemic areas characterized by moist soils or stagnant water, hence elevating the risk [7].

3.5. Clinical Features

The most common first signs are fever, headache followed by changes in mental state and stiffness in the neck [11].The majority of cases are characterized by focal neurological impairments, such as hemiparesis, quadriparesis, or spastic paraparesis, and these deficits tend to aggravate at rapid rates [12]. Cranial nerve palsies present a unique characteristic, predominantly involving the sixth, seventh, ninth, and tenth nerves. This leads to facial weakness, double vision, or difficulty in swallowing [13]. Certain patients exhibit presentations or symptoms that mimic those of stroke, neurodegenerative disorders, or demyelinating diseases[14]. Facial pain, rapid onset of cranial neuropathies, and brainstem symptoms are frequently found in neuromelioidosis following dental procedures, occasionally within days of dental procedure [7].

3.6. Diagnosis

A complete clinical evaluation and the patient's medical history help distinguish neuromelioidosis from other infections or central nervous system strokes, facilitating further evaluation for the beginning of the treatment. The diagnosis requires increased focus, particularly in endemic locations or after recent dental procedures. Laboratory confirmation is achieved through cultures from blood, CSF, sputum, or affected tissue that are positive. MRI is critical for defining

specific lesions and differentiating them from malignancy, abscess, and tuberculosis [14]. CSF findings: Mononuclear pleocytosis, elevated protein, normal/low glucose [8]. Radiographic findings: MRI frequently reveals microabscesses following the pathways of white matter tracts, particularly in the frontoparietal lobes, corticospinal tract, and cerebellar peduncles. Moreover, it displays the unique "Tunnel sign," characterized by linear enhancement along these neural tracts [12]. Blood and sputum**:** Definitive diagnosis frequently relies on isolating *Burkholderia pseudomallei* from clinical samples such as pus, blood, sputum brain tissue[17]. The use of more recent mass spectrometry techniques, such as MALDI-TOF MS, and next-generation sequencing could be of assistance in the process of quick identification, particularly in situations that are uncommon [18].

3.7. Management and Treatment

The intensive-phase therapy consists of intravenous administration of ceftazidime or meropenem for a duration of 2 to 4 weeks, sometimes extended depending upon the severity of the condition. Subsequently, oral eradication therapy is administered with trimethoprim-sulfamethoxazole for a duration of 3 to 6 months. [15] Initiation of treatment must occur promptly due to the elevated risk of fatality and enduring neurological impairments if postponed. [16]

3.8. Outbreak of Neuromyeliodosis

Recently, Tamil Nadu experienced outbreaks that involved more than 20 cases, with numerous instances connected to exposures at dental clinics due to contaminated saline. The cases were observed, with the principal incidence occurred at a dental clinic located in Vaniyambadi a small town in the Thirupathur district and the surrounding districts between July 2022 and April 2023. Blood and cerebrospinal fluid (CSF) samples were cultivated using automated methods, and *B. pseudomallei* isolates were identified by the use of conventional biochemical tests. This was then followed by confirmation with the VITEK MS-MALDI TOF (bioMerieux) system. The investigation discovered a neurotropic strain of *B. pseudomallei* (ST1553) that is closely related to isolates found in Australia and India. This strain carries the *B. mallei*-like *bimA* allele, which was associated with neuroinvasion. [7] In northern Australia, melioidosis—particularly its neurological form occurs frequently, with seasonal outbreaks often following periods of heavy rainfall or flooding [19]. In Hainan Province, southern China, the disease is also endemic, and several reports have described neuromelioidosis cases presenting as encephalitis, brain abscesses, or stroke-like syndromes [20].

3.9. Preventive measures

Initial preventive measures include proper history-taking and identifying existing infections or patients at risk, reducing environmental exposures, dental clinics maintaining strict infection control, and managing risk factors.These can lower disease rates that lead to better clinical outcomes. All reusable dental instruments like handpieces, probes, scalers, forceps, and surgical tools should be thoroughly cleaned first to effectively eliminate *B. pseudomallei*, and also should then undergo high-level disinfection and sterilization. *Geobacillus stearothermophilus* is the biological indicator that is used to check autoclaving. The correct temperature for the specified duration should be maintained during the process of autoclaving. All surfaces, including dental chairs, trays, counters, and handles, should be disinfected with appropriate solutions (1% sodium hypochlorite) to remove Gram-negative bacteria and to prevent contact between patients. The clinics should always keep sterile and non-sterile areas separated and the disposal instruments shouldnever be reused.

To prevent infection transmission in dental settings, it is essential that saline bottles used for irrigation are opened fresh for each patient, ensuring no cross-contamination occurs. Small quantity (100ml) saline bottles can be used for each patient to prevent wastage. Both clinicians and patients should consistently wear appropriate protective equipment including masks, head caps, gloves, and eyewear, to minimize the risk of cross-infection. Additionally, all impressions and casts sent to the laboratory must be thoroughly disinfected prior to shipment, safeguarding against microbial contamination and maintaining patient and staff safety. Dental clinics should be fumigated at proper interval of time and disposable instruments and materials should be used wherever possible.

4. Conclusion

Neuromelioidosis remains as one of the underappreciated threats in the clinical practice. Evidence from the Tamil Nadu outbreak, supported by international studies, indicates that inadequate sterilization and infection control can result in the direct transmission of severe neuromelioidosis. This risk is particularly associated with the reuse of contaminated saline solutions and improper handling of dental instruments, both of which have been linked to high mortality rates. This article summarises the etiology, nature of the disease, preventive and management measures for neuromyeliodosis. Implementing these measures in both dental and medical settings particularly in endemic areas can

safeguard vulnerable patients and significantly reduce the likelihood of future outbreaks and serious neurological complications.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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