INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH AND INNOVATIVE STUDIES
ISSN: 2820-7157
www.ijsrisjournal.com

December 2024 **Volume 3** **Number 6** **Pages 90-93**

Received Date: November 05, 2024 **Accepted Date:** November 26, 2024 **Published Date:** December 01, 2024

Available Online at https://www.ijsrisjournal.com/index.php/ojsfiles/article/view/266

https://doi.org/10.5281/zenodo.14270511

Mycetoma: Diagnosis and Future Treatment Strategies - A Comprehensive Review

Omaimah Abdullah Aldubian[1], Maryam Khalid Alhajraf[1], Maryam Abdulla Alsalem[1], Mariam Salman Alhmoud[1], Maryam Ali Alsaeed[1], Bushra Hussain Alkhamis[1], Heba Hussain Al-Ali[1], Maryam Mohammed Alsaeed[1], Tamadher Najib Almusailim[2], Zainab Saeed Albilady[3], Zainab Abdulwhab Alrashed[3], Sara Mohammed Alkarri[1], Nourah Mohammed Alzhrani[1], Fatima Ali Alalwan[1], Salamah Hussain Alabdullah[1]

1.Maternity and children Hospital

2.ALRASHDIAH PHC

3.ALRASHDIAH PHC

ABSTRACT

Mycetoma is a chronic, progressively destructive infectious disease caused by fungi (eumycetoma) or bacteria (actinomycetoma). It is endemic in tropical and subtropical regions, particularly in countries within the "mycetoma belt," including Sudan and India. The condition often leads to severe morbidity due to delayed diagnosis and limited treatment options, resulting in deformities and disabilities. This review provides an overview of the diagnostic methods, challenges, and promising future treatment strategies, including pharmacological advancements, immunotherapy, and preventive measures.

1. Introduction

Mycetoma is recognized by the World Health Organization (WHO) as a neglected tropical disease. It is characterized by subcutaneous swelling, sinus tract formation, and discharge containing grains (microcolonies of the causative organism). The disease predominantly affects individuals in rural areas, with farmers and manual laborers being at higher risk due to prolonged exposure to traumatic injuries involving soil or plant material(1).
The lack of early detection tools and effective therapies exacerbates the disease burden. Current treatment regimens have limitations, including long duration, high cost, and significant side effects, especially for eumycetoma(2).

2. Etiology and Epidemiology

Mycetoma is caused by over 70 species of microorganisms, categorized as:

- **Actinomycetoma:** Caused by bacterial agents such as *Nocardia* and *Actinomadura*.
- **Eumycetoma:** Caused by fungal species, most commonly *Madurella mycetomatis*.

Regions such as Sudan, Mexico, and India report high prevalence rates due to climatic factors and occupational exposure. In Sudan, *M. mycetomatis* is the leading cause of mycetoma(3,4).

3. Diagnosis

Accurate and early diagnosis of mycetoma is crucial for effective management but remains challenging due to resource constraints in endemic regions.

3.1. Clinical Diagnosis

- **Signs and Symptoms:** Swelling, multiple sinuses, and discharge with grains are hallmark features. However, these are non-specific and overlap with other subcutaneous infections(5).

3.2. Imaging

- **Ultrasound:** Used to differentiate eumycetoma (hyperechoic grains) from actinomycetoma (hypoechoic grains)(6).
- **MRI and CT Scans:** Valuable in assessing the extent of tissue and bone involvement.

3.3. Microscopic Examination

- Direct observation of grains in discharge or biopsy specimens helps identify the causative organism(7).

3.4. Culture

- Culturing grains on specific media is the gold standard but requires weeks and has low sensitivity(8).

3.5. Molecular Diagnostics

- PCR-based techniques offer rapid and precise identification of the organism but are rarely available in endemic areas due to cost(9).

3.6. Serological Tests

- Serodiagnostic assays, such as ELISA for *M. mycetomatis*, are under development but not widely used clinically(10).

4. Current Treatment Strategies

The choice of treatment depends on the type of mycetoma:

4.1. Actinomycetoma

- **Antibiotics:** Combination therapy with sulfamethoxazole-trimethoprim (SMX-TMP) and amikacin is effective. The treatment duration ranges from 6 months to a year(11).

4.2. Eumycetoma

- **Antifungal Agents:**
    - Itraconazole is the first-line drug, requiring long-term use (up to 2 years).

- Voriconazole and posaconazole are alternative options but are costly(12,13).

- **Surgical Intervention:** Amputation or excision of affected tissue is often required in advanced cases.

5. Challenges in Current Management

- **Drug Resistance:** Resistance to antifungal and antibacterial drugs is an emerging issue.
- **Toxicity and Accessibility:** Long-term therapy with antifungal drugs leads to severe side effects, and their availability is limited in resource-poor settings(14).
- **Diagnosis Delays:** Lack of awareness and diagnostic facilities contributes to delayed treatment and worse outcomes.

6. Future Treatment Strategies

6.1. Novel Antifungal Agents

- *Fosravuconazole*, a new triazole antifungal, has shown promise in early trials for eumycetoma due to better tissue penetration and fewer side effects(15).

6.2. Immunotherapy

- Immunomodulatory therapies that boost host defenses against mycetoma pathogens are being explored. Adjuvant cytokine therapy could improve outcomes.

6.3. Nanotechnology-Based Drug Delivery

- Nanoparticle formulations enhance the bioavailability of antifungal agents, reducing toxicity and treatment duration.

6.4. Gene Editing Techniques

- CRISPR/Cas9-based approaches for engineering resistance genes in fungal species hold potential for tackling antifungal resistance.

6.5. Vaccines

- Research into vaccines targeting *M. mycetomatis* antigens is underway, although clinical trials are yet to begin.

6.6. Point-of-Care Diagnostics

- Development of rapid diagnostic kits for field use will facilitate early detection and reduce treatment delays.

7. Preventive Strategies

- **Protective Measures:** Wearing shoes and gloves can reduce trauma exposure, particularly for agricultural workers.
- **Public Awareness:** Education campaigns in endemic regions can improve early diagnosis and treatment-seeking behavior.
- **Environmental Interventions:** Limiting exposure to contaminated soil and vegetation through environmental modifications may decrease incidence rates.

8. Conclusion

Mycetoma is a debilitating disease that requires comprehensive efforts in early diagnosis, effective treatment, and preventive strategies. Advances in molecular diagnostics, immunotherapy, and nanotechnology offer hope for better management in the future. However, addressing barriers such as drug resistance, cost, and accessibility remains critical to reducing the global burden of mycetoma. Collaborative research and international support are essential to achieving these goals.

References

1. Emery D, Denning DW. The global distribution of actinomycetoma and eumycetoma. Vol. 14, PLoS Neglected Tropical Diseases. 2020.

2. van de Sande WWJ. Global Burden of Human Mycetoma: A Systematic Review and Meta-analysis. PLoS Negl Trop Dis. 2013;7(11).

3. Hao X, Cognetti M, Burch-Smith R, Mejia EO, Mirkin G. Mycetoma: Development of Diagnosis and Treatment. Vol. 8, Journal of Fungi. 2022.

4. Beer KD, Blaney DD, Kadzik M, Asiedu KB, Shieh WJ, Bower W, et al. A Call to Action for Mycetoma. Vol. 12, Current Fungal Infection Reports. 2018.

5. Clark CG. Mycetoma. El Sheikh Mahgoub, MB, BS, Dip Bact, PhD, Khartoum, and I. G. Murray, MB, MRC Path, DTM & H, London. 216 × 140 mm. Pp, 132 + vii. Illustrated. 1973. London: William Heinemann Medical Books Ltd. £3.50. British Journal of Surgery. 2005;61(7).

6. Fahal AH, Sheik HE, Homeida MMA, Arabi YE, Mahgoub ES. Ultrasonographic imaging of mycetoma. British Journal of Surgery. 1997;84(8).

7. Fongwen N, Asiedu KB, Bakhiet S, Bonifaz A, Cruz I, Argaw D, et al. Diagnostics to support mycetoma management—Development of two target product profiles. Tropical Medicine and International Health. 2022;27(12).

8. Limid W, Siddig E, Eadie K, Nyuykonge B, Ahmed S, Fahal A, et al. The development of a novel diagnostic PCR for Madurella mycetomatis using a comparative genome approach. PLoS Negl Trop Dis. 2020;14(12).

9. Riwes MM, Wingard JR. Diagnostic methods for invasive fungal diseases in patients with hematologic malignancies. Vol. 5, Expert Review of Hematology. 2012.

10. Ahmed AA, van de Sande W, Fahal AH. Mycetoma laboratory diagnosis: Review article. Vol. 11, PLoS Neglected Tropical Diseases. 2017.

11. Bonifaz A, Tirado-sánchez A, Vazquez-gonzalez D, Araiza J, Hernández-castro R. Actinomycetoma by Actinomadura madurae: Clinical Characteristics and Treatment of 47 Cases. Indian Dermatol Online J. 2021;12(2).

12. van de Sande W, Taha H, Fahal A. Mycetoma: epidemiology, treatment challenges, and progress. Res Rep Trop Med. 2015;

13. Nyuykonge B, Lim W, van Amelsvoort L, Bonifaz A, Fahal A, Badali H, et al. Eumycetoma causative agents are inhibited in vitro by luliconazole, lanoconazole and ravuconazole. Mycoses. 2022;65(6).

14. Scolding P, Fahal A, Yotsu RR. Drug therapy for Mycetoma. Cochrane Database of Systematic Reviews. 2018;2018(7).

15. Brüggemann R, Nyaoke B, Ahmed ES, Siddig EE, Egondi T, Oyieko P, et al. S4.5b A randomized, double blind phase II proof-of-concept superiority trial of fosravuconazole 200 mg or 300 mg weekly dose versus itraconazole 400 mg daily, all three arms in combination with surgery, in patients with eumycetoma in Sudan—pharmacokinetic results. Med Mycol. 2022;60(Supplement_1).