Editorial

Electrolyte disruption in drug-resistant tuberculosis: Managing risks for improved treatment outcomes

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ARTICLE INFO

ABSTRACT

This editorial sheds light on the critical issue of electrolyte imbalance in drug-resistant tuberculosis (TB), a significant challenge exacerbated by the prolonged and intensive treatment regimens required for multidrug-resistant (MDR) and extensively drug-resistant (XDR) TB strains. The use of second-line drugs, such as fluoroquinolones and aminoglycosides, necessary in these cases, often disrupts electrolyte homeostasis, leading to complications like hypokalemia and hypomagnesaemia. These disturbances can pose serious risks to patients, including cardiac arrhythmias and renal dysfunction. Beyond medication effects, TB itself induces systemic inflammation and metabolic alterations, further complicating electrolyte balance. Effective management necessitates vigilant monitoring of electrolyte levels throughout treatment, coupled with renal function assessments and nutritional support.

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1. Editorial

Tuberculosis (TB), has affected mankind for centuries, remaining as a significant global health issue.[1] The emergence of drug-resistant strains of the *Mycobacterium tuberculosis*, particularly multidrug-resistant tuberculosis (MDR-TB) and extensively drug-resistant tuberculosis (XDR-TB), has further complicated treatment regimens and outcomes.[2] Beyond the resistance mechanisms themselves, another critical concern in the management of drug-resistant TB is the impact on electrolyte balance.

Electrolytes are essential minerals in the body that carry an electric charge, crucial for various physiological functions, including nerve conduction, muscle contraction, and maintaining fluid balance.[3] When tuberculosis becomes resistant to first-line drugs like isoniazid and rifampicin, patients often require longer and more complex treatment with second-line drugs, which can lead to electrolyte imbalances due to their pharmacological properties and side effects.

One of the primary challenges in managing electrolyte imbalances in drug-resistant TB lies in the medications themselves. Second-line drugs such as aminoglycosides (e.g., amikacin), and certain other agents like linezolid can disrupt electrolyte levels.[4–7] Further, aminoglycosides can cause both hypokalemia and hypomagnesemia. These disturbances can lead to serious complications if not promptly identified and managed. Moreover, vomiting, diarrhea, and sweating also potentiates the electrolyte imbalances. This ultimately have a direct effect in the mechanism of other anti-tuberculous drugs. Newer drugs like bedaquiline and delamanid could result in the prolongation of QTcF levels but this could be attributed to the underlying electrolyte imbalances which can be corrected.[4,8]

Moreover, the extended duration of treatment required for drug-resistant TB increases the risk of cumulative

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electrolyte disturbances over time. Patients may also face challenges in maintaining adequate nutrition and hydration during treatment, which further potentiates the risk of electrolyte imbalance.

Beyond pharmacological considerations, the disease itself can contribute to electrolyte imbalances. Tuberculosis often leads to systemic inflammation and metabolic alterations, which can further disrupt electrolyte homeostasis.[9] For instance, increased levels of pro-inflammatory cytokines may affect renal function and electrolyte handling.[10]

The management of electrolyte imbalances in drug-resistant TB requires a multidisciplinary approach. Close monitoring of electrolyte levels, particularly potassium, magnesium, and calcium, is essential throughout the treatment course.[11] Regular renal function tests are also crucial to detect early signs of kidney damage, which can exacerbate electrolyte disturbances.

Healthcare providers must be vigilant in educating patients about the signs and symptoms of electrolyte imbalances, emphasizing the importance of adherence to treatment and dietary recommendations. Nutritional support, including supplementation when necessary, plays a vital role in maintaining electrolyte balance and supporting overall health during TB treatment.[11]

Research into novel treatment regimens for drug-resistant TB should also prioritize minimizing the impact on electrolyte balance. This includes exploring new drug combinations or formulations that are less likely to cause significant electrolyte disturbances.

In conclusion, while drug-resistant tuberculosis poses formidable challenges to global health, the management of electrolyte imbalances represents a critical aspect of patient care. Healthcare providers must remain proactive in monitoring and addressing these imbalances to optimize treatment outcomes and minimize complications. Through continued research and clinical vigilance, we can advance our understanding and management of this complex interplay between tuberculosis and electrolyte balance, ultimately improving the quality of life and prognosis for patients worldwide.

2. Source of Funding

3. Conflicts of Interest

None declared.

References

1. Bloom BR, Atun R, Cohen T, Dye C, Fraser H, Gomez GB, et al. Tuberculosis. In: Holmes K, Bertozzi S, Bloom B, editors. Major Infectious Diseases. 3rd edn. Washington (DC): The International Bank for Reconstruction and Development / The; 2017. Available from: https://www.ncbi.nlm.nih.gov/books/NBK525174/. doi:10.1596/978-1-4648-0524-0_ch11.
2. Shanmuga P, Mani AP, Geethalakshmi S, Yadav S. Advancements in Artificial Intelligence for the Diagnosis of Multidrug Resistance and Extensively Drug-Resistant Tuberculosis: A Comprehensive Review. *Cureus*. 2024;16(5):60280. doi:10.7759/cureus.60280.
3. Shrimanker I, Bhattarai S, Electrolytes. Electrolytes. [Updated 2023 Jul 24]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024. [Last accessed 2024, Jun 7]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK541123/.
4. Guidelines for programmatic management of drug resistant tb in India 2021. [Last accessed 2024, Jun 7]. Available from: https://tbcindia.gov.in/WriteReadData/l892s/8368587497Guidelines%20for%20PMDT%20in%20India.pdf.Lastaccessed2024.
5. Prasad R, Singh A, Gupta N. Adverse drug reactions in tuberculosis and management. *Indian J Tuberc*. 2019;66(4):520–32. doi:10.1016/j.ijtb.2019.11.005.
6. Roger C, Roberts JA, Muller L. Clinical pharmacokinetics and pharmacodynamics of oxazolidinones. *Clin Pharmacokinet*. 2018;57(5):559–75.
7. Tanaka R, Suzuki Y, Morinaga Y. A retrospective test for a possible relationship between linezolid-induced thrombocytopenia and hyponatraemia. *J Clin Pharm Ther*. 2021;46(2):343–51.
8. Guidelines for use of delamanid in the tteatment of drug resistant tb in India 2018. [Last accessed 2024, Jun 7]. Available from: https://tbcindia.gov.in/WriteReadData/l892s/8131480597Guidelines%20for%20use%20of%20Delamanid%20for%20treatment%20of%20DR-TB%20in%20India.pdf.
9. D'Attilio L, Santucci N, Bongiovanni B, Bay ML, Bottasso O. Tuberculosis, the Disrupted Immune-Endocrine Response and the Potential Thymic Repercussion As a Contributing Factor to Disease Physiopathology. *Front Endocrinol (Lausanne)*. 2018;9:214. doi:10.3389/fendo.2018.00214.
10. Kathamuthu GR, Moideen K, Sridhar R, Baskaran D, Babu S. Systemic levels of pro-inflammatory cytokines and post-treatment modulation in tuberculous lymphadenitis. *Trop Med Infect Dis*. 2023;8(3):150. doi:10.3390/tropicalmed8030150.
11. Companion handbook to the WHO guidelines for the programmatic management of drug-resistant tuberculosis. Geneva: World Health Organization; 2014. ANNEX 7, Management of electrolyte disturbances; 2014. [Last accessed 2024, Jun 7]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK247438/.

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