Life & Science 2024 Vol. 5, No. 2

EDITORIAL

Nanoantibiotics: A Tool Against Antimicrobial Resistance

Wasim Alamgir, Adnan Haider

Antimicrobial Resistance (AMR), is one of the biggest emerging threats to human health and healthcare systems. Experts are suggesting that the post-antibiotic era, in which microbial infections and minor injuries will again become fatal, is near. A report published by the Antibiotics Resistance Collaborators, in the Lancet, reported that 1.27 million people died due to antibiotic-resistant bacterial infections in 2019.[1] Deaths could reach 10 million by 2050 if the problem is not addressed. Antimicrobial resistance arises as a natural adaptation of microorganisms to environmental challenges. One typical self-defense mechanism is by producing enzymes that inactivate antimicrobial agents. Bacteria can also become resistant to β-lactams by producing β-lactamase, and by altering binding sites for antimicrobials agents (resistance to glycopeptide antibiotic agents), expressing multidrug efflux pumps such as tigecycline resistance to Acinetobacter baumannii, and limiting cell permeability for antibiotics such as Acinetobacter baumannii and pseudomonas aeruginosa.[2,3]

In the early 20th century, infectious diseases were the major cause of death. The advent of antibiotics led to a significant decrease in mortality.[4] However, antibiotics resistance has now reached a threshold that is invalidating commonly used antibiotic agents. Currently the attempts to manage microbial resistance to antibiotics include the development of novel antimicrobial agents. However, there is no guarantee that the introduced new antimicrobial agents would be able to cope with the microbial resistance effectively and efficiently.[5]

Apart from developing new antibiotics, the chemical modification of existing antimicrobial agents is emerging as an upcoming strategy to combat antimicrobial resistance.[4-6] Research on the effect of antibiotic associated nanoparticles on bacterial function is being conducted with the hope that advances in nanotechnology will lead to strategies for reconfiguration of presently available antibiotic molecules.

Several nanomaterials have been identified as alternates for combating antimicrobial resistant strains. Each metallic and ceramic nanomaterials and more specifically their nanoparticles have their own peculiar antimicrobial properties. Studies have reported that these nanoparticles can be surface-functionalized with antimicrobial agents or molecules to further enhance their antimicrobial efficacy.[6] Engineering antibiotics into nanoscale or functionalizing nanoparticles with antibiotic agents allows them to penetrate microbial cells and reach their target sites with precision and accuracy. Studies have shown that in contrast to free antibiotics, tailored functionalized nanoparticles and small antibiotic molecules have improved binding affinities and target specificity.[6] Currently, these nanotechnology-based solutions have reported some problems like cytotoxicity, targeted selectivity, and bulk production. However, with concrete planning and a cohesive approach from academia, industry, and government, the development of nanoantibiotics drugs of unique shapes and sizes, high surface areas, ability to carry antibiotic drugs to target sites, and protein disruption will help overcome antimicrobial resistance.

Editor-in-Chief

How to cite this: *Alamgir W, Adnan H. Nanoantibiotics: A Tool Against Antimicrobial Resistance. Life and Science. 2024; 5(2): 130-131. doi: http://doi.org/10.37185/LnS.1.1.657*

REFERENCES

1. Antimicrobial Resistance Collaborators. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. Lancet, 2022; 399: 629-55. doi: 10.1016/S0140-6736(21)02724-0

2. Francesca B, Viviana O, Rosalba G, Giovanni B, Flavia M. Nanoantibiotics to fight multidrug resistant infections by Gram-positive bacteria: hope or reality?. Biotechnology Advances. 2022; 57: 107948. doi: 10.1016/j.biotechadv.2022.107948
3. Zeinab B, Buthaina J, Rafik K. Resistance of Gram-Negative Bacteria to Current Antibacterial Agents and Approaches to Resolve It. Molecules. 2020; 6: 1340. doi: 10.3390/molecules25061340
4. Ae JH, Young JK. Nanoantibiotics": a new paradigm for treating infectious diseases using nanomaterials in the antibiotics resistant era. Journal of Controlled Release. 2011; 156: 128-45. doi: 10.1016/j.jconrel.2011.07.002
5. Cassini A, Högberg LD, Plachouras D, Quattrocchi A, Hoxha A, Simonsen GS, et al. Attributable deaths and disability-adjusted life-years caused by infections with antibiotic-resistant bacteria in the EU and the European Economic Area in 2015: a population-level modelling analysis. The lancet. 2019; 1: 56-66. doi: 10.1016/S1473-3099(18)30605-4
6. Mustafa MM, Adeola JS, Mariya M, Eric PV. Nanoantibiotics: Functions and Properties at the Nanoscale to Combat Antibiotic Resistance. Frontiers in chemistry. 2021; 9: 687660. doi: 10.3389/fchem.2021.687660

....