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(REVIEW ARTICLE)

The role of antibiotics in the treatment of bacterial infections: A literature review

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Abstract

Bacterial infections continue to be a major public health challenge due to the large number of potential pathogens and varying disease states from mild or asymptomatic to life-threatening conditions. The increasing threat of antibiotic resistance poses significant challenges in the treatment of bacterial infections, primarily stemming from the misuse and overuse of antibiotics. The emergence of multidrug resistant organisms such as *Acinetobacter baumannii*, which compromises the arsenal of treatment options that healthcare providers have to manage diseases, has led to the development of increased resistance in microbes; therefore, appropriate policies need to be implemented to combat antibiotic resistance and ensuring effective treatment. A comprehensive understanding of these evolving treatment modalities, alongside stringent adherence to prescribing guidelines, is crucial for overcoming the current antibiotic crisis and improving patient care.

Keywords: Bacterial; Antibiotics; Drug; Treatment

1. Introduction

Few other strides in contemporary medicine have had the perspective as much as the unearthing of antibiotics. These wonder drugs have completely changed the approach to the management of bacterial infections in the human body, drastically reducing mortality and increasing the quality of life for so many (Muteeb et al., 2023)[1]. The innovation of antibiotics marked a revolution in public health during the late 1940s as it enabled effective management of treatable diseases that once proved life-threatening (Gaynes, 2017)[2]. All in all, perhaps nothing is as troubling in health systems around the world, though as pressing a matter as is the rising tide of antibiotic resistance. It speaks to an intricacy wherein an awareness not just of how these compounds work but also the results of overuse and misuse is required (Aslam et al., 2018)[3]. Only then can their proper role in healing bacterial infections be fully appreciated for its lifesaving abilities while simultaneously recognizing the immediate call for what has come to be known as responsible stewardship in saving that effectiveness for future generations.

1.1. Bacterial infections and the significance of antibiotics in treatment

1.1.1. Definition

Bacterial infections continue to be a major public health challenge due to the large number of potential pathogens and varying disease states from mild or asymptomatic to life-threatening conditions (WHO, 2023)[4]. After all, one of the increasingly worrisome opportunistic pathogens is Acinetobacter baumannii, because it is a multi-drug-resistant strain, which compromises the arsenal of treatment options that healthcare providers have to manage diseases. Antibiotics treatment for bacterial infections plays an important role in disease management because it is crucial to achieve better

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control and outcomes with infection (Uddin et al., 2021)[5]. Misuse and overuse of antibiotics have led to the development of increased resistance in microbes; therefore, appropriate policies need to be implemented.

Several studies have admitted that such a program was effective in stemming resistance and promoting the rational use of antibiotics (Funes, 2019)[6]. Furthermore, innovative approaches, including the use of bacteriophages, are being explored alongside traditional antibiotics to enhance treatment efficacy against resistant strains (Styles et al., 2020)[7]. Thus, understanding the dynamics of bacterial infections and the strategic use of antibiotics is crucial in combating resistance and ensuring effective treatment.

1.1.2. Mechanism of Action of Antibiotics

Antibiotics specifically interfere with a very particular process that is necessary for bacterial life and replication; most of the time, they inhibit growth or wipe them out entirely. The action of these drugs can be broadly grouped into two main classes: bactericidal or bacteriostatic. Bactericidal antibiotics like penicillin interrupt synthesis related to the bacterial cell wall and then, by osmotic forces, the cell lyses (Lillestolen et al., 2018)[8]. Bacteriostatic antibiotics inhibit proteins that are used by bacteria to replicate themselves, therefore stopping their proliferation while not necessarily killing them. This action is very important for the therapeutic activities of the bacteriostatic agents included in them since bacterial pathogenicity depends on proteins' normal function; then, the immune system of the body can eradicate an infection much more efficiently. Consequently, understanding these mechanisms is essential for developing effective treatments and combating antibiotic resistance (Mongold, 2020)[9].

1.1.3. How antibiotics target bacterial cells and inhibit their growth

Antibiotics play a critical role in the treatment of bacterial infections by specifically targeting various important structures and processes in bacteria. For example, some antibiotics inhibit the synthesis of the cell wall and the bacterial cell integrity as it weakens; this eventually may lead to lysis of bacteria. Another mechanism by which some antibiotics work is to inhibit protein synthesis since they directly bind to bacterial ribosomes. Meanwhile, other classes of antibiotics work by interfering with nucleic acid synthesis, which is vital for cell division and functioning. However, with antibiotic-resistant strains, treatment becomes complicated; on a positive note, strains that are deficient in adhesion are also less virulent and less pathogenic (Cusumano, Klein and Hultgren, 2016)[10]. Further supporting this is an urgent need for new therapies that can efficiently act on mechanisms related to bacterial adhesion. As demonstrated in research on cystic fibrosis, where bacterial virulence factors play a significant role in lung infections, addressing bacterial adherence might open new avenues for treatment, emphasizing the evolving nature of antibiotic intervention (Depluverez, Devos and Devreese, 2016)[11].

1.1.4. The Impact of Antibiotic Resistance

Antibiotic resistance is a major preoccupation of modern medicine since it threatens the efficiency of the treatment of bacterial infections. An important dimension of the increasing difficulty in the management of infections relates to the rapid emergence of ARB causing conditions hitherto amenable to treatment, which is associated with higher morbidity and mortality. This pressure on the hospitals as the major primate locations for the driving spread of ARB is associated with the higher pressure due to the large use of antibiotics that leaps up the spread of resistance via selective pressure on bacterial populations (Almagor et al., 2018)[12]. A further exacerbating factor is the presence of bacterial cells that can survive an antibacterial treatment and may act as hosts for the spread of resistance genes in host tissues (Davidson, 2021)[13]. All this results in increased costs, longer stays, and more complex treatment regimens. Combatting antibiotic resistance demands robust stewardship interventions and innovative strategies to preserve the effectiveness of existing antibiotics while ensuring patient safety.

1.1.5. Factors contributing to antibiotic resistance and its implications for treatment

The increasing prevalence of antibiotic resistance poses significant challenges in the treatment of bacterial infections, primarily stemming from the misuse and overuse of antibiotics. Inadequate prescribing habits are often practiced, such as the unjustified use of broad-spectrum antibiotics without definitive diagnoses. In particular, the management of complicated intra-abdominal infections (IAIs) illustrates how this phenomenon unfolds, it was found that inappropriate initial antimicrobial therapy is related to patient outcome and the emergence of resistant pathogens (Sartelli et al., 2017)[14]. The biochemistry of such resistance is not widely enough known to make specific reactions in time and, indeed, in just the United States, results in several thousand deaths every year (Lillestolen, 2018)[15]. With multi-drug-resistant organisms increasingly prevalent, the outcomes are dire for treatment and thus highlight the urgent need for research into new therapeutic strategies and calls for improved prescribing behaviors if the antibiotic resistance crisis is to be countered effectively.

2. Conclusion

The rising challenges regarding antibiotic resistance make it crucial to reassess the ways in which we consider treatment of bacterial infections. According to a study conducted vigilance concerning the policies of antimicrobial prescription. It varies greatly and is much stronger in one special type of infection, lower respiratory tract infections, than in sepsis or urinary tract infections. This lack of homogeneity is evidence of the problems that exist within clinical practice and need to be addressed to improve the treatment results. Another area of the prospect of phage therapy being a promising alternative to conventional antibiotics, especially against multidrug-resistant bacteria. The sensitivity of phage therapy to be used either as an alternative or complement to antibiotics underscores the approach toward management of infections that must involve many facets (Lin, Koskella and Lin, 2017)[16]. Ultimately, a comprehensive understanding of these evolving treatment modalities, alongside stringent adherence to prescribing guidelines, is crucial for overcoming the current antibiotic crisis and improving patient care.

Compliance with ethical standards

Acknowledgments

The increasing threat of antibiotic resistance greatly elevates the urgent need for responsible use of antibiotics in managing bacterial infections. Misuse of antibiotics through over-prescription, or the non-completion of treatment courses, diminishes the influence of these life-saving medicines and, therefore, increases the prevalence of resistant bacteria. This condition thus not only complicates the treatment of common infections but also becomes a tremendous challenge for public health systems worldwide. Effective strategies should ensure the promotion of appropriate prescribing practices among healthcare providers together with patient education advocacy for treatment adherence. The use of awareness campaigns may bring about a better sense of when to use antibiotics, hence reducing usage in those cases where they are not warranted. In the end, without responsible use, these lifesaving drugs will quickly fail in delivering treatment benefits. Safeguarding advances in modern medicine and improving health outcomes for all individuals facing bacterial infections.

Disclosure of conflict of interest

The Authors declare that there is no conflict of interest.

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