Analysis on the Current Research into the Efficacy of Antibiotic Alternatives

Abstract

As bacteria become antibiotic resistant a need for research into alternative treatments increases. This is an evaluation of the current antibiotic resistance crisis. It addresses cause and effect with an emphasis on predicting research opportunities for possible solutions. Said solutions evaluated are phage therapy, probiotics, and diet. The main finding discussed is the potential of dietary supplementation and the addition of probiotics to fight bacterial infection. This concept is supported by a meta analysis done on chronic urinary tract infections and the efficacy of alternative treatments.

Introduction

On the forefront of microbiology-based research is the need to discover new treatments for bacterial pathogens. The driving force for this research is the emergence of antibiotic resistant bacteria. Antibiotics thus far have been a highly effective and versatile treatment option, causing doctors to overprescribe and farmers to over use. In addition, scientists have lacked incentives to research alternatives. The main focus of this paper is to explain why antibiotic resistance is a problem, evaluate findings on natural remedies for infection, and highlight areas of future research.

The Root Cause

Antibiotics are currently imperative to modern medicine, but their overuse has led to antibiotic resistance. One particular draw is that they target structures only present in bacterial cells, leaving human cells unharmed. This allows doctors to mass prescribe antibiotics, as they do not discriminate between different bacterial infections. Therefore, doctors do not have to take time identifying specific pathogens before prescribing treatment, resulting in overprescription, as antibiotics are given at the slightest indication of a bacterial infection. A physician can prescribe antibiotics without confirming if bacteria are present. In addition to health practice, a large contributor to the overuse of antibiotics comes from agriculture practices [1]. Due to the fact that antibiotics were thought to have minimal health effects, a large number of farmers use them to mass treat their animals as a preventative measure. They do this as an attempt to decrease the risk of foodborne illness. Despite their good intentions, the consequences have been severe.

It is because of their effectiveness and seeming lack of repercussion that the search for alternatives was all but abandoned. For example, phage therapy was discovered before antibiotics, but its progress stilled upon their discovery [1]. However, a call for new treatment options has recently developed, and the investigation into phages has been reinstated. The term discovery void describes the disheartening reality that in the last 25 years the invention of new antibiotics has slowed. Despite the push for development, no current research has been successful in finding a new antibiotic since the 1980's [1]. The lack of new antibiotics contributes to antibiotic resistance. As bacteria become antibiotic resistant, they prosper and replicate. The lack of variety in possible antibiotics allows this resistance to prevail because bacteria only need to be resistant to a couple to become dangerous. In addition, the lack of new antibiotics means that treatments cannot be alternated to further decrease the impact of natural selection because there are not enough options to do so.

Possible Solutions

Phage therapy is currently one of the main topics of exploration into antibiotic alternatives. Phage therapy is the use of viruses to target bacterial cells. As of now, it is highly unreliable, and most phages require extensive creation in the lab. Because they have to be tailored to the specific bacteria causing the infection, phages are only viable for a couple of hours. In infections with multiple types of bacteria, phage therapy is rendered ineffective [1].

Another realm of research is centered around prebiotics and probiotics. Prebiotics are substrates that one can consume to support the growth of probiotics, which are beneficial bacteria. The intent is to diversify the gut flora, strengthen the immune system; and create more competition, which hinders possible pathogens. Probiotics tend to be a blend of the same bacteria: namely *Lactobacillus* and *Bifidobacterium.* Their presence helps decrease the abundance of gram negative bacteria. This benefits human health because gram negative bacteria contain lipopolysaccharides, which are endotoxins [2].

Perhaps the most interesting approach focuses on natural alternatives. Products such as essential oils have been written off due to the emergence of false claims and multi-level marketing schemes selling products as miracle cures. Homeopathy has been construed as a pseudoscience, but there may be more truth in the treatment than originally thought. In the vanguard of discovery, it has come to light that a wide variety of plants have antimicrobial properties in some capacity [3]. If the stigma surrounding homeopathy can be overcome, a treatment plan is obtainable by pairing modern day medicine with the body's natural drive to cure itself.

Future of Research

A large hindrance to research is the ethical aspect of testing antibiotic alternatives on humans. To treat an individual that has a bacterial infection with a medication that may not work when antibiotics are available is a risk that outweighs the benefit. This results in studies that are limited to individuals that have antibiotic resistant infections or non-human agriculture based studies, which makes finding relevant research on the topic difficult. This demonstrates an open niche for research and calls for action. Further research into antibiotic alternatives is necessary, as studies centering around antibiotic resistant bacteria may not provide a proper evaluation on the efficacy of said alternatives.

Noting the lack of human studies on non antibiotic resistant bacteria does not negate the hopeful results seen in studies done on antibiotic resistant bacteria. One inspiring meta analysis by Jitendra et al. evaluated the efficacy of cranberry juice, probiotics, vitamin A, and vitamin D as treatment for children with chronic urinary tract infections. In comparison to placebo: cranberry juice, probiotics, and vitamin A all had positive outcomes as treatment. When evaluated against antibiotics, cranberry juice and probiotics were just as effective [4]. The findings show that dietary supplementation and the addition of probiotics have the potential to fight bacterial infection. These results are promising and support the need for further research.

Conclusion

Overall the amount of research on antibiotic alternatives is limited. Antibiotic resistance and gut health make this topic important. Utilizing probiotics, a diet that promotes healthy microflora, and hesitation to prescribe antibiotics would hopefully result in a decrease in the prevalence of antibiotic resistant pathogens and an increase in overall diversity of the microbiome.

Primary Reference

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Supplemental References

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