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PHARMA HIGHLIGHTS

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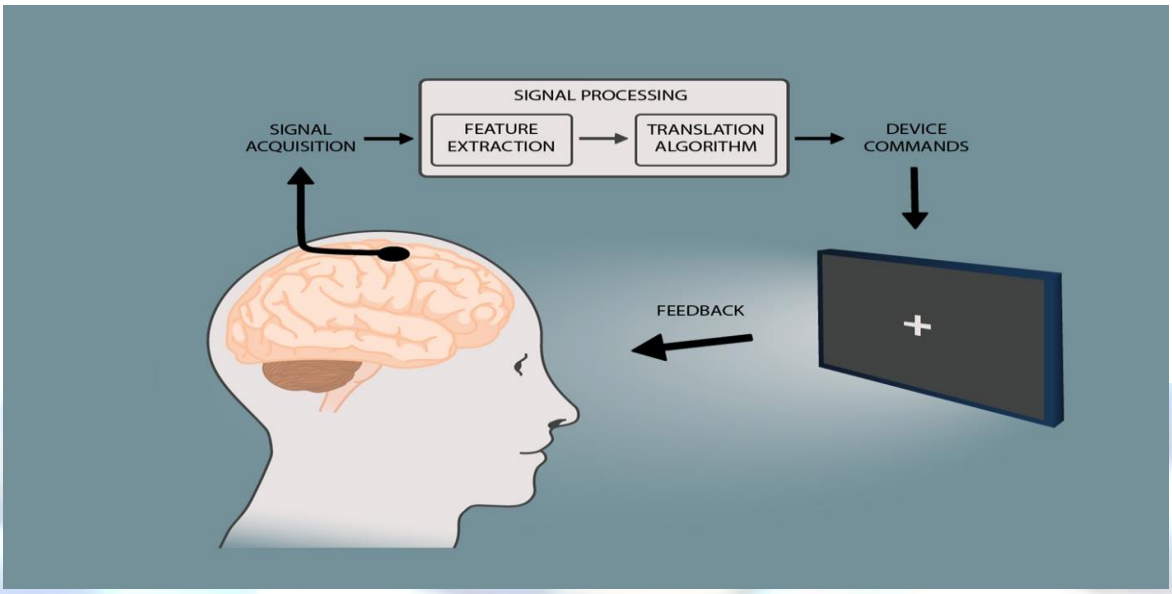
Implantable Brain-Computer Interface Technology: A Major Breakthrough for Paralysis



Spinal cord injury, stroke, or multiple sclerosis are some of the major debilitating conditions leading to paralysis which exerts a detrimental effect on the individual as well as on the society and economy. The neurons located in the lumbosacral region are essential in walking and disruption of these neurons and descending pathways of the spinal cord region which affects the brain-derived commands necessary for walking, leading to permanent paralysis. Although there are numerous intriguing pre-clinical investigations being conducted, no therapeutic intervention has been established till date that has been proven to significantly enhance neurological outcomes or lessen the effects of secondary neuronal injury. In a recent study published by Swiss researchers, the use of Brain-computer interface (BCI) technology was identified as a novel, muscle-independent method that served as a digital bridge to restore the communication between the rain and the spinal cord which enabled patients with chronic tetraplegia to walk normally.

The brain–computer interface consists of subdural surface electrodes which rely on a feedback loop to record neuroelectric signals from the brain which is followed by the extraction of specific features from the acquired signals, and the translation of these features into a control signal for a computer. Surgically implanted BCI in the brain specifically in the cortex is composed of fully implanted recording and stimulation systems that provide an instantaneous link between the cortical signals and the analogue modulation of epidural electrical stimulation targeting the regions of the spinal cord leading to walking. The subdural surface electrodes in the BCI are placed over the dominant-hand motor cortex and connect to a subcutaneously-implanted transmitter below the clavicle enabling continuous monitoring of electrocorticographic (ECoG) activity hence this digital bridge serves as a framework to restore natural control of movement after paralysis. In conclusion, the current rate of technological and neuroscientific advancement makes it evident that BCIs will eventually be used in clinical settings at a wider range and become available for clinicians in order to administer to patients who are losing or who have lost their ability to walk due to paralysis.

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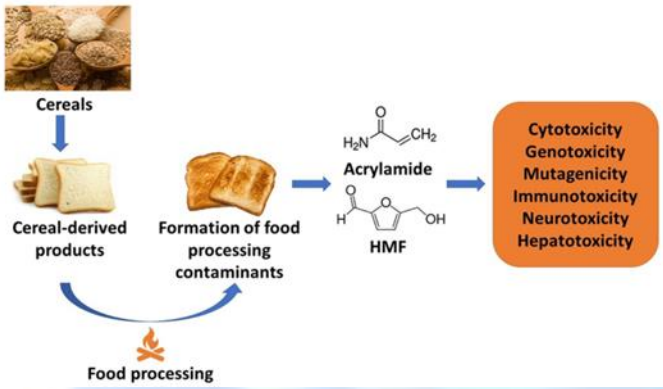
Our Very Common Food Additives, Being the Inducer of Genotoxicity



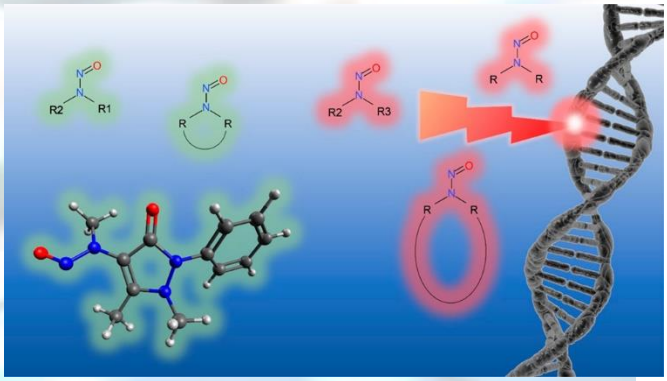
Genotoxicity refers to the ability of a chemical or an agent to exhibit a toxic effect on the genetic material of a cell. Sometimes, genotoxicity and mutagenicity are used interchangeably while mutagenicity is the property of an agent or a substance to create or induce mutations in DNA. Hence, all mutagens are genotoxic, not all genotoxic substances are mutagenic since genotoxins may be mutagens, carcinogens, or teratogens (Samanthi, 2013).

Inevitably businesses have enhanced the production of ready-made foods as well as food additives according to people's demand for snacks and more practical foods. Shelf life and preserving properties are important parameters for using food additives. However, excessive consumption of ready-made foods and also additives render carcinogenic and mutagenic effects on the human body (Ayaz and Yurttagül, 2012). 10 carcinogenic N-NAs(N-nitrosamines) including NMEA, NDMA, NDEA, NDPA, NDBA, NMA, NMOR, NSAR, NPIP and NPYR have been found in different types of foodstuffs such as- cured meat products, processed fish, cocoa, alcoholic beverages, processed vegetables, cereals, milk, dairy products, and spiced foods. The most important food group contributing to nitrosamines exposure is meat and meat products (EFSA, 2023).

Mechanism of genotoxicity:

The genotoxic substances interact at a specific base sequence of the DNA structure causing lesions, breakage, mis-segregation or nondisjunction which lead to damage and mutation. Nitrosamines exert their toxic and mutagenic effects by alkylating N-7 of guanine, leading to destabilization and increased breakage of DNA. Activated nitrosamines also generate reactive oxygen species such as superoxide (O2−) and hydrogen peroxide (H2O2), and thereby increase oxidative stress, DNA damage, protein adduct formation and lipid peroxidation. This carcinogens-induced cellular injury is mediated by the generation of reactive oxygen species with attendant increased levels of superoxide, nitric oxide, and lipid peroxidation, all of which cause DNA damage. Radical ion accumulation leads to inhibition of oxidative metabolism, mitochondrial dysfunction, reduced ATP production, and finally cell death (National Library of Medicine, 2015).

To conclude, the presence of N-nitroso compounds in foods may be regarded as an etiological risk factor for certain human cancers. Therefore, more research is needed to control this hazard to a maximum extent.



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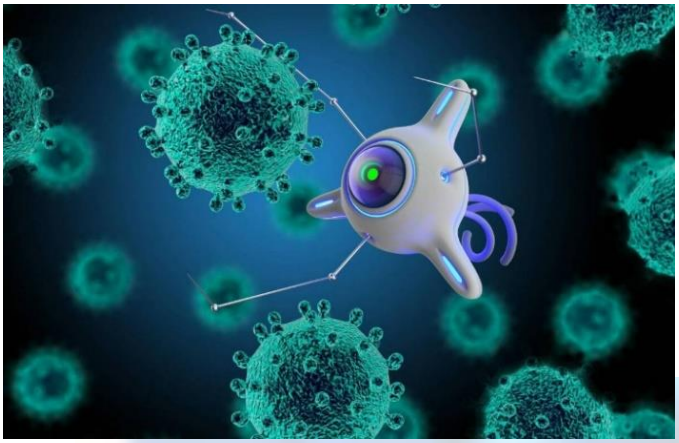
Miniature Healthcare Providers: Microbots for Treating Bladder Disease



Engineers from the University of Colorado—Boulder have created an innovative type of "microbot" that could revolutionize the treatment of various health conditions, including interstitial cystitis, a condition affecting millions of Americans annually. Recently published in Small, the microbots are being hailed as miniature healthcare providers due to their potential to transform the treatment landscape for interstitial cystitis and other ailments. Their tiny size, approximately 20 micrometers, allows them to swiftly navigate through the body, even faster than a cheetah. This remarkable characteristic presents groundbreaking opportunities for medical treatment.

In a small study, these microbots were introduced into mice and loaded with dexamethasone, a commonly used steroid medication for interstitial cystitis. The results demonstrated their immense potential to effectively deliver medications to various body areas, with the microbots specifically attaching themselves to the bladder to prevent being expelled through urine. The researchers envision that this targeted delivery approach could be adapted for other medical conditions by designing microbots to seek out specific body regions. The future implications of these microbots as versatile treatment vehicles hold great promise for advancing medical care.

This presents an exceptionally novel approach to treating interstitial cystitis, a bladder condition associated with severe pelvic pain. The current standard of care involves administering dexamethasone doses directly to the bladder using a catheter, which can be uncomfortable for patients. However, with the introduction of the new microbots, individuals can now receive dexamethasone doses gradually over approximately two days, eliminating the need for multiple visits and providing extended exposure to a beneficial medication.

Despite the promising potential, there are still significant tasks ahead before these microbots can be applied to human patients. One important objective for the researchers is to develop biodegradable microbots, ensuring they break down safely within the body over time. This continued effort will be crucial to advancing the application of microbots in medical treatments effectively.

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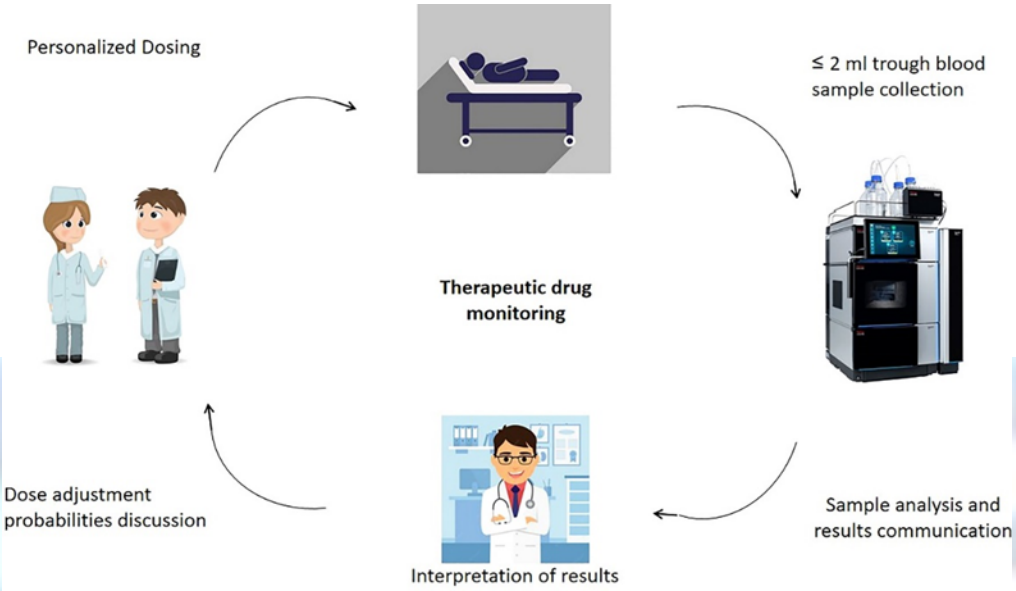
Preventing Risks Associated with Antibiotic Use: Therapeutic Drug Monitoring (TDM)



Antibiotics are one of the greatest discoveries with the potential to become a global threat. Nowadays, the overuse or underdosing of antibiotics is a common occurrence in human beings. Antibiotic over-prescription or overdose is associated with a higher risk of severe infection consequences, loss of immunity, and even an increase in the fatality rate. However, without endangering the lives of our patients, we can decrease the number of infections that are currently treated needlessly with antibiotics by administering proper doses. Moreover, certain fixed-dose antibiotics have been shown to be linked to a higher probability of treatment failure, and there are limited practical methods for dose adjustment. Ongoing research is focused on discovering novel strategies for selecting the optimal dose of antibiotics for individuals.

Additionally, therapeutic drug monitoring (TDM) and numerous clinical trials have been implemented to increase efficiency and reduce the adverse effects of antibiotics with narrow therapeutic windows. Antibiotic blood concentrations can now be continuously monitored to enhance effectiveness and prevent underdosing and overdosing, which can promote bacterial regeneration and the development of antibiotic-resistant species. Multiple studies have shown that TDM improves the recommended use of antibiotics in various hospitalized populations, including critically ill patients, with immediate positive effects on outcomes. Certain fixed-dose antibiotics have been found to be associated with a higher likelihood of treatment failure, and there are limited practical methods for adjusting the dosage. Therefore, several studies have been conducted to evaluate the effectiveness of different interventions in promoting more accurate antibiotic use. The goal is not only to minimize the use of antibiotics to reduce side effects but also to recommend antibiotics only to patients who are expected to benefit from the medication. This approach aims to develop appropriate antibiotic use and highlight the individualized processes for optimal treatment of infections while analyzing the framework and key factors for the therapeutic administration of antibiotics.

In addition to reducing side effects by using antibiotics less frequently overall, the ultimate goal of TDM and other treatments designed to promote optimal antibiotic use is to ensure that only patients who are expected to benefit from them are prescribed antibiotics. By emphasizing the importance of using antibiotics carefully in order to address the growing problem of antibiotic resistance, this strategy complies with the antimicrobial stewardship principles.

To summarize, therapeutic drug monitoring (TDM) is essential for maximizing antibiotic therapy. Healthcare providers can increase the effectiveness of treatment and lower the danger of under or over-dosing as well as the emergence of antibiotic resistance by regularly monitoring antibiotic blood concentrations. TDM has proven useful in a variety of patient demographics, including those who are critically ill. It is a crucial tool for

promoting appropriate antibiotic usage and enhancing patient outcomes.

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