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Dual benefits of cardiovascular therapeutics for cardiovascular disease and anxiety treatment

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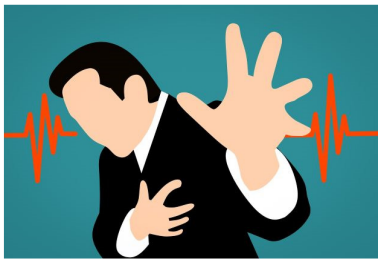
The cardiovascular disorders, hypertension, coronary artery disease, and mental disturbances, such as anxiety and depressive disorders are the most common problems among the people, which are causing the high rate of morbidity and death. Anxiety and depression deteriorate the cardiovascular disease and pathologies. On the other hand, the cardiovascular diseases may cause the mental and emotional disturbances. There is bidirectional relationship between the psychological disturbances and cardiovascular diseases. Therefore, the patients with cardiovascular diseases should be examined and treated for their disturbances of emotions, cognition, and behavior (Repova et al., 2022).



When patients with heart or vasculature disturbances take principal cardiovascular drugs, the medicines can interact with the mental state of the patient and optimize their therapeutic benefit. The beta-blockers, central sympatholytics, ACE inhibitors, ARBs, aldosterone receptor blockers, sacubitril/valsartan, and fibrates are presumed to have anxiolytic effect in animal experiments and clinical settings. Therefore, when the patients with cardiovascular diseases are treated, their mental condition, cognition and behavior should be taken into account to select the cardiovascular drugs, which can provide them with benefit for both mental disturbances and cardiovascular disorders.

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Various theories for developing Alzheimer's disease

Dr Md Anawar Hossain

Alzheimer's disease

Alzheimer's disease (AD) causes a neurodegenerative disorder, and slowly progressive impairment in memory and executive function in the older people, which currently affects >5.5 million individuals.
Alzheimer's disease largely causes dementia and morbidity in the global population. The extracellular amyloid beta (A*β*) plaques and neurofibrillary tangles are accumulated in the brain of the patients with Alzheimer's disease, which is the main factor causing Alzheimer's disease (Eid et al., 2022).

The symptoms of Alzheimer's disease or clinical diagnosis is normally observed in older age or late stage of life. But the process of developing Alzheimer's disease actually starts early in life in a prolonged presymptomatic phase of life. Although some treatments can improve symptoms of memory loss, but these therapies can't stop or prevent the progressive development of Alzheimer's disease or death of cell. Although a lot of research has been conducted over the past decades, currently available therapies are not yet potentially successful, because the patients are already in the advanced stage of disease. Another reason is that clinical trials are not successful due to too late intervention in the disease process when therapies are unlikely to be effective (Paranjpe et al., 2022).

Piccirillo et al. (2022) reported that oxidative stress, metabolic alterations, and mitochondrial dysfunction play a key role in the development and worsening of Alzheimer's disease. Therefore, researchers have taken different initiatives and efforts to develop neuroprotective strategies, which can prevent the impairment of mitochondrial dynamics and cell redox status.

Connection between microprotein and Alzheimer's disease risk

In the mitochondria of cells, the researchers found a tiny microprotein, called SHMOOSE, which is encoded by a newly discovered gene (University of Southern California, 2022). When a mutation occurs within this gene, the SHMOOSE microprotein becomes partially inactivated leading to a rise as much as 20-50 % higher risk for Alzheimer's disease.

DDT exposure contributes to Alzheimer's disease risk

Based on their experimental data and previous epidemiological findings, Eid et al. (2002) indicated that dichlorodiphenyltrichloroethane (DDT) pesticide exposure may contribute to increased risk of amyloid precursor protein by impacting the amyloid pathway. Furthermore, they reported a mechanism that linked the pesticide DDT to Alzheimer's disease (Florida International University, 2022).

Predicting conversion of mild cognitive impairment to Alzheimer's disease

Patients with Mild Cognitive Impairment (MCI) have an increased risk of Alzheimer's disease. Treatment at the early stage of Alzheimer's disease is more effective than that at the late stage. Therefore, early identification of Alzheimer's disease can help clinicians to provide better treatment and improve the condition of the Alzheimer's disease patients (Rye et al., 2022).

Synthesis of human amyloid restricted to liver results in an Alzheimer disease

Lam et al. (2021) identified that a probable cause of Alzheimer's disease was the leakage from blood into the brain of fat-carrying particles transporting toxic proteins. Professor John Mamo and his collaborative group of Australian scientists had identified the probable 'blood-to-brain pathway' that can lead to Alzheimer's disease, the most prevalent form of dementia globally.

Autoimmune theory for Alzheimer's disease

Weaver (2022) believes that beta-amyloid is a normally occurring molecule, but not an abnormally produced protein. The beta-amyloid is part of the brain's immune system, which plays a significant role to repair the body injuries and fight against microbial attack. But there are great similarities between the fat molecules that make up both the membranes of bacteria and the membranes of brain cells. Therefore, beta-amyloid cannot differentiate the invading bacteria and host brain cells, and mistakenly attacks the very brain cells, while it should be protected. This process is believed to cause a chronic, progressive loss of brain cell function resulting in development of dementia. The brain's immune system performs a misdirected attack on the very organ that should be defended by it. Thus, Alzheimer's disease emerges as an autoimmune disease.

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Multimodal molecular imaging in medical monitoring, diagnosis, and treatment

Dr Md Anawar Hossain

Molecular imaging

Molecular imaging is a powerful interdisciplinary imaging technology that performs the in vivo imaging and describes the molecular biology of human body organs (Wu and Shu, 2018). This technique can depict and elucidate living biological processes at the tissue, cellular and molecular level in a non-invasive manner. It can also monitor and diagnose disease changes and monitor human health. Molecular imaging can detect the abnormal changes in cells and molecules causing the diseases and help to identify the early tumor diagnosis and indication of diseases.

Multimodal molecular imaging

Different types of molecular imaging techniques are currently under use. These techniques have their own advantages, disadvantages, and limitations in terms of the spatial/depth resolution and sensitivity, making the achievement of precise and reliable information at the disease site. Therefore, we need to develop a more advanced and high-performance imaging technique to overcome these disadvantages and limitations.

Researchers have combined two or more imaging techniques to create a new imaging system, such as multimodal molecular imaging for obtaining some further information in diagnosis, treatment, and monitoring. Wu and Shu (2018) discussed the benefits of the classic molecular imaging technology and proposed some of the latest multimodal molecular imaging modes.

Benefit of multimodal molecular imaging

- Multimodal molecular imaging is presumed to produce a better result and more accurate information regarding monitoring, diagnosis, and treatment of difficult diseases.
- This technique can help the healthcare professionals to perform screening, surveillance, staging, prognosis, planning and therapy guidance, monitoring therapy efficacy, and assessing recurrence.
- It may also aid in presymptomatic detection, targeted therapy, and personalized medicine.
- It has shown promising results in the treatment of cardiovascular diseases, neuropsychiatric diseases, and other clinical diseases.
- It can significantly enhance the positioning of the tumor border and effectively guide the surgical resection of the tumor.

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Quality, ratio and adverse reactions of inactive ingredient/excipients in medicine

Dr Md Anawar Hossain

Possible adverse reactions by excipients

The excipients used in medicines should be pharmacologically inactive, non-toxic, and non-reactive with the active ingredients or other excipients. Actually, few excipients fulfil the above ideal characteristics. Some excipients are proved to be not inert, and they have ability to react with other ingredients in the formulation. They also cause adverse and hypersensitivity reactions in patients which can be a mild rash to a potentially life-threatening reaction (Haywood and Glass, 2011). The excipients, either solid powder or solvents, used in the manufacturing of medicines or their by-products/residues may cause multiple toxicities (Haywood and Glass, 2011). Different pharmaceutical manufacturers use different excipients, especially preservatives and colourants to produce the same drug. The Consumer Medicines Information provides a list of excipients, and information on the safety of individual excipients can be found in drug reference guides.

Some patients face an adverse reaction after ingestion of medicines, and they are not sure how they are encountering adverse reactions. The adverse reactions may occur not always from the active ingredient, but also it may result from the similar ingredients if the patient is sensitive to those, or if the patient is taking multiple medicines. The adverse reaction may occur if the quantity of excipients may be high relative to body weight, especially for premature babies. The adverse reaction might result from the excipients contained in their current and past medication history too. Therefore, the patient should identify which factors are causing their individual adverse effects.

Diluents or fillers can significantly affect the physico-chemical properties of the final tablet thus affecting the biopharmaceutical profile. As for example, calcium salts, used as fillers, can interfere with the absorption of tetracycline from the gastrointestinal tract indicating that excipients may not always be inactive or inert material in a drug (Dave, 2008). Therefore, the pharmaceutical manufacturers should carefully select the diluents, binders, lubricants and glidants to avoid the adverse reactions, but maintain the product stability and disintegration capacity for drug release after ingestion.

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Use of 3D printing technology in personalised drug design and delivery

Dr Md Anawar Hossain

What is three-dimensional (3D) printing?

It is a promising additive manufacturing technology, which can manufacture 3D objects for developing various drug delivery systems for pharmaceutical applications. Drug delivery is a system through which formulation is developed for drug manufacturing and drug transportation into human body to control disease. In the 3D printing techniques, the thermoplastic polymers or hydrogel materials are deposited in sequential layers one on top of another to produce 3D object.

Challenges and solution strategies

There are some hindrances for the application of 3D printing techniques in commercial-scale production. The current drug delivery system should be modified to produce 3D printed dosage forms with different drug release patterns and properties. The 3D printing techniques can play a role in the drug delivery and development of patient-specific medicines. However, most of the materials used in pharmaceutical manufacturing are not suitable for the current 3D printing techniques. Therefore, further research is needed to develop and adapt the 3D techniques to suit with a wider range of materials. Future research should focus on developing cost-effective printing technologies and compatible materials for these printers, which can produce a range of 3D objects.

3D printing technique in personalized medicine

The advancement of science and technologies in pharmaceutical field has created many new ideas for the design of drugs, manufacturing technology, and processes to produce high quality of dosage form. Drug delivery, development and manufacturing process emphasize the physicochemical and biopharmaceutical characteristics of active pharmaceutical ingredients (API) and regulatory requirement.

In a same country, there are different types of people in respect to their eating habits, profession, living styles, ethnic background and individual differences. In some multi-cultural countries, these differences are very higher than those in other countries. The patients in these countries have different ethnic backgrounds, eating habits, circadian cycles, and inter individual differences. Therefore, drug development experts encounter a lot of difficulties to deliver

uniformity in manufacturing medicine considering all of the human or personal differences. Therefore, recently, it has been essential to develop personalized medicine.

Three-dimensional (3D) printing technologies can play a significant role in manufacturing personalized medicine and producing innovative formulations and disease modelling. Technological development has aided the scientist to make innovation in pharmaceutical industry. The 3D printing technologies, computer-aided drug design and modelling have accelerated the production of personalized pharmaceutical drug products. Recently, 3D printing has been successfully applied to develop pharmaceutical formulations. However, the research and development scientists need to conduct further work to optimize the formulation, processes and equipment to produce the desired shape and size of the medicines. The FDA first time approved a 3D printed drug named SPRITAM (Levetiracetam) in August 2015.

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