RECENT ADVANCES IN NUCLEAR MEDICINE

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1 Abstract

Nuclear medicine has a long and illustrious history that has garnered enormous investment. New nuclear medicine methods have been developed as a result of these investments, which may detect diseases non-invasively and provide information that cannot be obtained with existing imaging technologies, as well as give tailored treatments. Overall, the use of nuclear medicine procedures is rapidly increasing, particularly as new imaging technologies such as positron emission tomography/computed tomography and single photon emission computed tomography/computed tomography improve the accuracy of disease detection, localization, and characterization, and as cyclotron automation and miniaturization, as well as advances in radiochemistry, make radiotracer production more practical. Recent advancements in the life sciences, such as molecular biology, genetics, and proteomics, have sparked the creation of better ways for identifying and treating disease based on a person's unique profile, a concept known as "personalized medicine." Research that provides a better understanding of normal and pathological processes, greater knowledge of the mechanisms by which individual diseases arise, superior identification of disease subtypes, and better prediction of an individual patient's treatment responses will help personalized medicine grow. The process of improving patient care, on the other hand, is complicated and time-consuming. Expanding the use of nuclear medical procedures has the potential to speed up, simplify, and lower the costs of developing and delivering better health care, as well as make customized medicine easier to execute. In this paper we are going to discuss recent advances in the field of nuclear medicine, it's advantage, it's design disadvantages and also walk through the future prospects in the field of nuclear medicine.

2 Introduction

Nuclear medicine's current clinical applications include the ability to diagnose diseases like cancer, neurological disorders, and cardiovascular disease in their early stages, allowing for earlier treatment and lower morbidity and mortality. Non-invasively assess therapeutic response, reducing patients' exposure to the toxicity of ineffective treatments and allowing alternative treatments to be started sooner and provide molecularly based information.

Emerging opportunities in the field of nuclear medicine consists of its capability in understanding the relationship between brain chemistry and behaviour; assessing the atherosclerotic cardiovascular system; assessing the efficacy of new drugs and other forms of treatment, speeding their introduction into clinical practise; and using targeted radionuclide therapeutics to individualize treatment for cancer patients by tailoring the dose. Further, build new technological platforms to help researchers find and validate novel molecular imaging probes, biomarkers, and radio therapeutic drugs more quickly and at a reduced cost. Produce higher-resolution, more sensitive imaging devices for detecting and quantifying illness more quickly and correctly; improve radionuclide production, chemistry, and automation to lower the cost and increase the availability of radiopharmaceuticals by inventing a new miniaturized particle accelerator and associated technologies to produce short-lived radionuclides for local use in research and clinical programmes; and develop and exploit hybrid imaging instruments, such as positron emission tomography/magnetic resonance imaging (PET/MRI) to improve disease diagnosis and treatment.

3 Current Developments

Nuclear medicine's current clinical applications include the capacity to:

1. Diagnose diseases in their early stages, such as cancer, neurological disorders (e.g., Alzheimer's and Parkinson's diseases), and cardiovascular disease, allowing for faster treatment and lower morbidity and mortality.

2. Assess therapy response noninvasively, decreasing patients' exposure to the toxicity of unsuccessful medicines and allowing alternative treatments to be started sooner; and offer cancer and some endocrine diseases with molecularly focused treatment (e.g., thyroid disease and neuroendocrine tumors).

4 Emerging opportunities:

In nuclear medicine, new opportunities include the potential to:

1. Recognise the link between brain chemistry and behaviour (for example, addictive behaviour, eating disorders, and depression).

2. Determine the state of the atherosclerotic cardiovascular system.

3. Learn about new drug metabolism and pharmacology.

4. Evaluate the efficacy of novel medications and other therapies in order to expedite their entry into clinical practise; by modifying the properties of the targeting vehicle and the radionuclide.

5. Use targeted radionuclide therapies to individualise treatment for cancer patients;

6. Build new technology platforms (for example, integrated microfluidic chips and other automated screening technologies) to speed up and minimise the cost of discovering and testing new molecular imaging probes, biomarkers, and radiotherapeutic medicines.
7. Develop higher-resolution, more sensitive imaging instruments to detect and quantify disease more quickly and accurately; further develop and exploit hybrid imaging instruments, such as positron emission tomography/magnetic resonance imaging (PET/MRI), to improve disease diagnosis and treatment; and improve radionuclide production, chemistry, and automation to reduce the cost and increase the availability of radiopharmaceuticals by inventing a new miniaturised particle accretion system.