Fortifying the pathway to hope with theranostics

Theranostics is helping provide a pathway to hope in treating advanced-stage cancer. A personalized approach to treating cancer, using both diagnosis and therapy as part of the treatment, theranostics brings together diagnostics and therapeutics where possible to evolve the promise of precision medicine. While theranostics may be used for different cancers in the future, to date most experience has been in metastatic prostate and neuroendocrine cancers.

Enabled by molecular imaging (MI) technologies such as positron emission tomography/computed tomography (PET/CT) and single photon emission tomography/computed tomography (SPECT/CT), the basic principle of theranostics relies on the utilization for both diagnostic imaging and therapy, of the same radiolabel agent with a specific metabolic pattern or molecular target.[1] Theranostics uses PET imaging to see if specific targets, known as tumor receptors, are present on tumor cells. If these targets are present and visible on the scan, a radioactive drug is used to treat the tumors. The radiotherapy agent is given as an injection and selectively targets the tumor cells while avoiding healthy organs.

Using this method enables clinicians to take a more personalized approach to treating each patient, while monitoring absorbed dose to help protect sensitive organs.

Evolving the promise of precision medicine with theranostics

The theranostic approach continues to gain interest and, in parallel, growth and discoveries are increasing in molecular imaging and personalized medicine. Theranostics may potentially help clinicians provide more customized management for different types of cancers, improve patient selection, enable prediction of treatment response, and determine patients' prognoses. Theranostics may also avoid futile and costly diagnostic examinations and treatments of many diseases that, without this approach, might be ineffective.[2]

With over 10M new cancer cases diagnosed per year worldwide and 10M cancer deaths in 2020 alone, cancer remains one of the most urgent health concerns.[3] Due to advances in precision diagnostics and treatment options enabled with theranostics, clinicians are increasingly moving away from a traditional one-size-fits-all perspective and toward individualized healthcare decisions for their patients.

The global market for theranostics is expected to grow from $80.4B in 2020 to $129.8B by 2025,[4] with a significant pipeline shift toward radiotherapeutics now that its differential clinical value has been established.[5] Industry partners such as GE Healthcare understand the strong clinical need for these treatments and are committed to investing in theranostics.

"GE Healthcare is uniquely able to support the growth expected in theranostics, from the discovery of new biomarkers to diagnosis and treatment monitoring with molecular imaging technologies and solutions," said Jean-Luc Procaccini, president and CEO of Molecular Imaging & Computed Tomography at GE Healthcare.

> *Evolving precision diagnostics with advanced imaging technologies have guided medicine toward more informed treatment and management of cancers and other diseases. These diagnostics and technologies also enable further progress as more theranostics treatments are developed and implemented.*

"As more health systems begin to implement theranostics programs, we're enabling a holistic solution to support the integration of precision diagnostics and therapeutics to achieve precise care. Theranostics is helping to drive a precise healthcare approach for oncology patients more than what we've traditionally seen, and we're working with our customers to make these treatments more accessible."

Addressing today's challenges in oncology with precise therapies

The number of patients in need of specialized care is growing. According to the Union for International Cancer Control, over 703 million people worldwide are currently over age 65, representing 9.1 percent of the global population. Estimates suggest that this proportion will rise to 15.9 percent, or 1.5B people, by 2050.[6] This growing aging population will affect cancer incidence, as cancer is more prevalent in older adults. In fact, more than 50 percent of people who have cancer are 65 or older.[7]

These population statistics reinforce the need for the continued development of precision diagnostics and therapies. Breast, lung, colon, and prostate cancer are commonly diagnosed.[8] Each cancer expresses differently in individual patients due to variables such as age, family history, genetics, and lifestyle.

Another factor impacting the need for more personalized cancer treatment is therapy resistance driven by the stage of diagnosis, tumor burden, growth and heterogeneity, physical barriers, and the patient's immune status.[9]

The strong clinical need for precision therapies and targeted treatments in oncology continues to fuel the search for new theranostics treatment opportunities. The goal is to exact more precise treatments and help improve cancer patients' quality of life and outcomes.

Supporting the clinical need for precision therapeutics

Molecular imaging is essential in theranostics to aid clinicians in visualizing disease with finer detail and to improve access to precision therapies. Additionally, innovative MI technologies, such as PET/CT and SPECT/CT, together with artificial intelligence (AI)-empowered digital applications are allowing repetitive assessment of the compound uptake and characterization of the tumor tissue and therapy response over time. Evolving precision diagnostics with advanced imaging technologies have guided medicine toward more informed treatment and management of cancers and other diseases. These diagnostics and technologies also enable further progress as more theranostics treatments are developed and implemented.

Simultaneously, academic researchers and pharmaceutical companies have accelerated the search for new biomarkers for disease subtypes, development or refinement of functional biomaterials, and novel theranostic pairs to expand clinical applications in theranostics. Several theranostic pairs have been developed, validated, and successfully used in treating lymphomas, neuroblastoma, neuroendocrine tumors, and certain prostate cancers.[10]

Successful theranostics treatments in prostate cancer

When clinically relevant prostate cancer is found and treated at an early stage before metastasis has occurred, treatments such as surgery and radiation often result in improved survival.[11] Worldwide, however, prostate cancer is the most diagnosed male malignancy and the fourth leading cause of cancer death in men.[12]

Despite advances in treating prostate cancer, certain prostate cancer types continue to grow even when the patients' hormone levels reach beyond the established low threshold. Theranostics efforts in prostate cancer are focused on treating these more lethal prostate cancers that are resistant to mainstream therapies. The theranostics approach in this case combines a targeting compound, prostate-specific membrane antigen (PSMA), with a radioactive particle, such as Lutetium-177 (^{177}Lu), which is injected into the patient and specifically targets the cancer cells.

The US Food and Drug Administration approved a new lutetium-based therapy, referred to as ^{177}Lu-PSMA-617 for theranostics treatment in prostate cancer.[13] The treatment is for adult patients with PSMA-positive metastatic castration-resistant prostate cancer (mCRPC) who have been treated with

The US Food and Drug Administration approved a new lutetium-based therapy, referred to as ^{177}Lu-PSMA-617 for theranostics treatment in prostate cancer. The treatment is an option for patients with prostate cancer that has spread and become resistant to hormone therapy and chemotherapy.

androgen receptor (AR) pathway inhibition and taxane-based chemotherapy. Many other small molecules and antibodies targeting PSMA have been developed and labeled, such as ^{161}Tb, ^{131}I, ^{90}Y, ^{67}Cu, and ^{47}Sc, and are currently being studied in preclinical and clinical studies.[14]

Expanding the potential of theranostics

As a leader in the industry, GE Healthcare is supporting the growth and development of theranostics programs with its holistic solutions. These solutions include providing access to emerging molecules with cyclotrons and PET radiochemistry systems for tracer development, production, and distribution and enabling accurate diagnosis and advanced monitoring of molecular therapies with innovative imaging systems such as PET/CT and SPECT/CT. Sophisticated tools for processing imaging data with AI-based reconstruction algorithms assist clinicians in rendering diagnoses and monitoring patients' progression through therapy.

Theranostics is an exciting and developing therapy option for a variety of cancers and has clinicians' support, who are eager to provide precision treatments to patients and improve outcomes. As the infrastructure is built to support theranostics as the standard of care, and more theranostics treatment pairs are developed, combining diagnostics and therapeutics holds the potential to improve patient management and outcomes in clinical areas beyond oncology.

Disclaimers

Not all products or features are available in all geographies. Check with your local GE Healthcare representative for availability in your country.

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