The role of positron emission tomography in diagnosis and treatment.

Lewis Dussek*

Department of Neurology and Neurological Sciences, Stanford University, Stanford, USA

Introduction

In the field of medical imaging, Positron Emission Tomography (PET) has emerged as a powerful tool for diagnosis and treatment in various medical specialties. This non-invasive imaging technique allows physicians to visualize and measure the metabolic and functional processes within the human body. By utilizing radiotracers and detecting the emitted positron particles, PET provides valuable insights into disease detection, staging, and treatment response assessment. In this article, we will explore the role of positron emission tomography in diagnosis and treatment and its impact on patient care.

Positron emission tomography relies on the principle of radioactive decay. A radiotracer, a biologically active molecule labeled with a positron-emitting radionuclide, is administered to the patient. The most commonly used radiotracer in PET imaging is 18F-fluorodeoxyglucose (FDG), which mimics glucose uptake in cells. Once injected, the radiotracer travels to the target tissues and emits positrons, which subsequently annihilate with nearby electrons, producing two coincident gamma rays. These gamma rays are detected by a ring of scintillation detectors surrounding the patient, allowing for precise localization of the radiotracer's distribution within the body [1].

One of the primary applications of PET is in the field of oncology. PET imaging with FDG has revolutionized cancer diagnosis and staging. Cancer cells typically exhibit increased glucose metabolism compared to normal cells, and this heightened metabolic activity can be visualized through FDG uptake on PET scans. By assessing the distribution and intensity of FDG uptake, physicians can identify the location and extent of tumors, aiding in accurate staging and guiding treatment decisions. PET scans can also help differentiate between benign and malignant lesions, facilitating early detection and intervention [2].

PET is not only valuable for initial cancer diagnosis but also plays a crucial role in treatment planning and monitoring. After the initiation of therapy, PET scans can assess the response to treatment by evaluating changes in tumor metabolism. A decrease in FDG uptake indicates a positive response to therapy, while persistent or increased uptake may suggest resistance or disease progression. This information allows clinicians to modify treatment strategies, potentially improving patient outcomes and avoiding unnecessary toxicities from ineffective therapies. Beyond oncology, PET imaging has demonstrated its utility in several other medical disciplines. In neurology, PET scans with specific radiotracers can aid in the early diagnosis and differential diagnosis of various neurodegenerative disorders, such as Alzheimer's disease and Parkinson's disease. These scans provide valuable insights into the distribution of abnormal proteins, such as amyloid beta and tau, and allow for accurate disease classification, prognosis, and evaluation of treatment response [3].

In cardiology, PET imaging can assess myocardial viability and blood flow. By utilizing radiotracers that are taken up by metabolically active myocardial cells, PET scans can determine the extent of viable tissue in patients with coronary artery disease or evaluate the response to revascularization procedures. Furthermore, PET imaging can identify areas of ischemia, assess myocardial blood flow, and detect microvascular dysfunction, aiding in the diagnosis and management of various cardiovascular conditions. Another emerging application of PET is in the field of radiation oncology. PET scans can be used for treatment planning in radiation therapy, enabling accurate target delineation and improving the precision of radiation delivery. By combining PET with computed tomography (CT) scans, clinicians can precisely localize tumor volumes and spare surrounding healthy tissues, minimizing treatment-related side effects. Additionally, PET scans during or after radiation therapy can assess treatment response and guide further management decisions [4].

Despite its numerous advantages, PET imaging does have some limitations. One significant challenge is the relatively high cost of PET scanners and the production of radiotracers. Additionally, PET requires specialized facilities and trained personnel to operate the equipment and interpret the results accurately. The availability of PET scanners may be limited in some regions, restricting patient access to this imaging modality. Furthermore, PET imaging involves exposure to ionizing radiation due to the use of radiotracers. Although the radiation doses used in PET scans are considered safe and well below the levels that can cause harm, it is essential to balance the potential benefits of the procedure with the associated radiation risks, particularly in vulnerable populations such as children and pregnant women. To address these challenges, ongoing research and technological advancements are focused on developing new radiotracers with improved specificity and sensitivity for various diseases. Additionally, efforts are being made to optimize the production process of radiotracers, making them more accessible and cost-effective [5].

***Correspondence to:** Lewis Dussek. Department of Neurology and Neurological Sciences, Stanford University, Stanford, USA, E-mail: dussek.lewis@stanford.edu

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Conclusion

Positron Emission Tomography (PET) has revolutionized the field of medical imaging by providing valuable insights into disease diagnosis, staging, and treatment response assessment. PET imaging, particularly with the widely used radiotracer FDG, has become an indispensable tool in oncology, aiding in tumor detection, staging, and treatment planning. PET has also demonstrated its utility in neurology, cardiology, and radiation oncology, providing valuable information for disease diagnosis, prognosis, and treatment guidance.

References

1. Gould MK, Maclean CC, Kuschner WG, et al. Accuracy of positron emission tomography for diagnosis of pulmonary nodules and mass lesions: A meta-analysis. JAMA. 2001;285(7):914-24.
2. Birim Ö, Kappetein AP, Stijnen T, et al. Meta-analysis of positron emission tomographic and computed tomographic imaging in detecting mediastinal lymph node metastases in nonsmall cell lung cancer. Ann Thorac Surg. 2005;79(1):375-82.
3. Volpi S, Ali JM, Tasker A, et al. The role of positron emission tomography in the diagnosis, staging and response assessment of non-small cell lung cancer. Ann Transl Med. 2018;6(5).
4. Weber WA, Petersen V, Schmidt B, et al. Positron emission tomography in non–small-cell lung cancer: Prediction of response to chemotherapy by quantitative assessment of glucose use. J Clin Oncol 2003;21(14):2651-7.
5. Tournoy KG, Maddens S, Gosselin R, et al. Integrated FDG-PET/CT does not make invasive staging of the intrathoracic lymph nodes in non-small cell lung cancer redundant: A prospective study. Thorax. 2007;62(8):696-701.

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