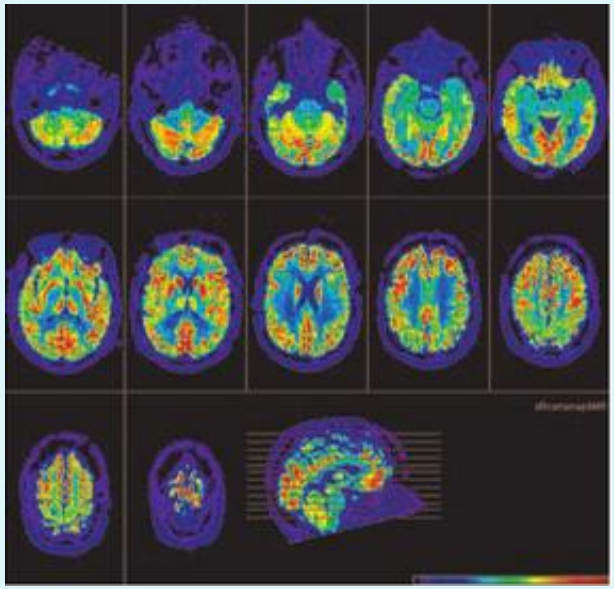
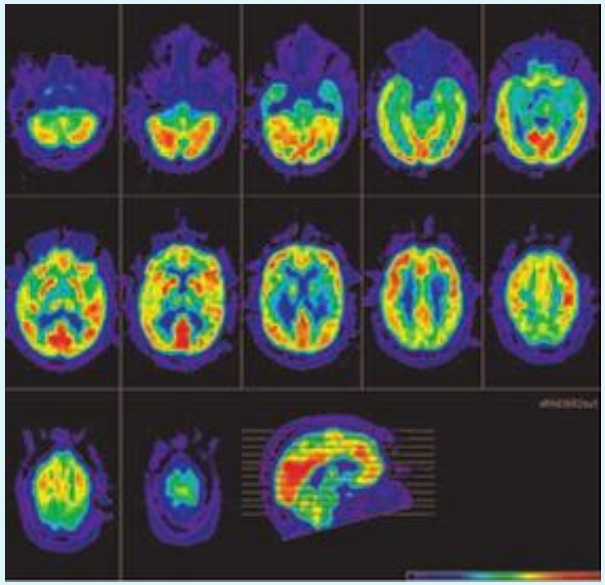
USE OF **PET** FOR CREATION OF IMAGE. MAIN MEDICAL USES





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1. Introduction

- ***Definition**: PET (positron emission tomography) is a tomographic imaging technique. It makes use of radiopharmaceuticals labeled with positron-emitting isotopes. It's based on the theoretical physical basis of annihilation.*

  - **Isotopes' characteristics:**
    - **Short life**
    - **High specific activity.**
    - **It doesn't change the molecule's physiological characteristics.**
    - **Common biological elements.**
    - **We get high quality images with a low radiation exposure for the patients.**

2. Physical principles: annihilation reaction

The radionuclide in the radiotracer decays and the resulting ***positrons*** subsequently annihilate on contact with ***electrons*** after traveling a short distance within the body. The annihilation event generates energy; the paired 511 KeV annihilation ***photons*** travel in ***opposite directions (180° apart)*** along a line.

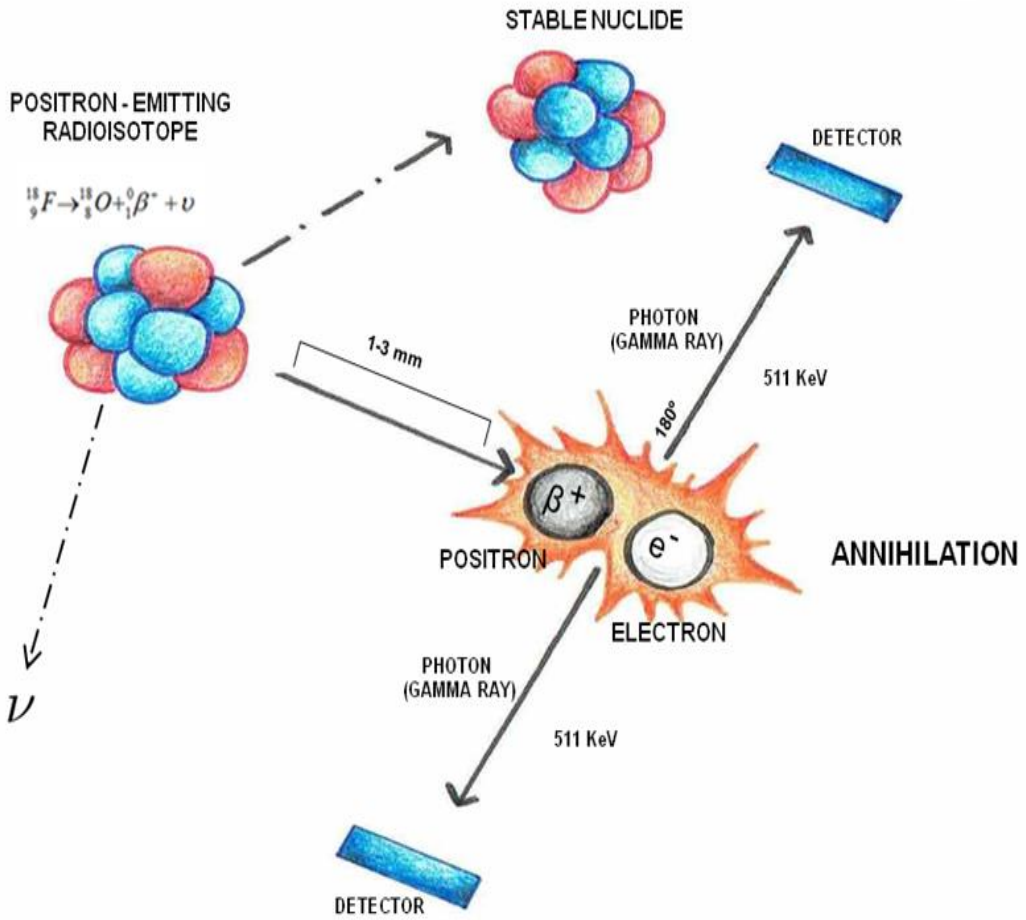


Diagram 1: annihilation reaction

3. PET image creation

- Positron-emitting isotopes are produced in cyclotrons or generators. Steps to obtain the images:

1.- Injection of a tracer compound labeled with a positron-emitting radionuclide into the patient.

2.- The tracer interacts with patient's molecules.

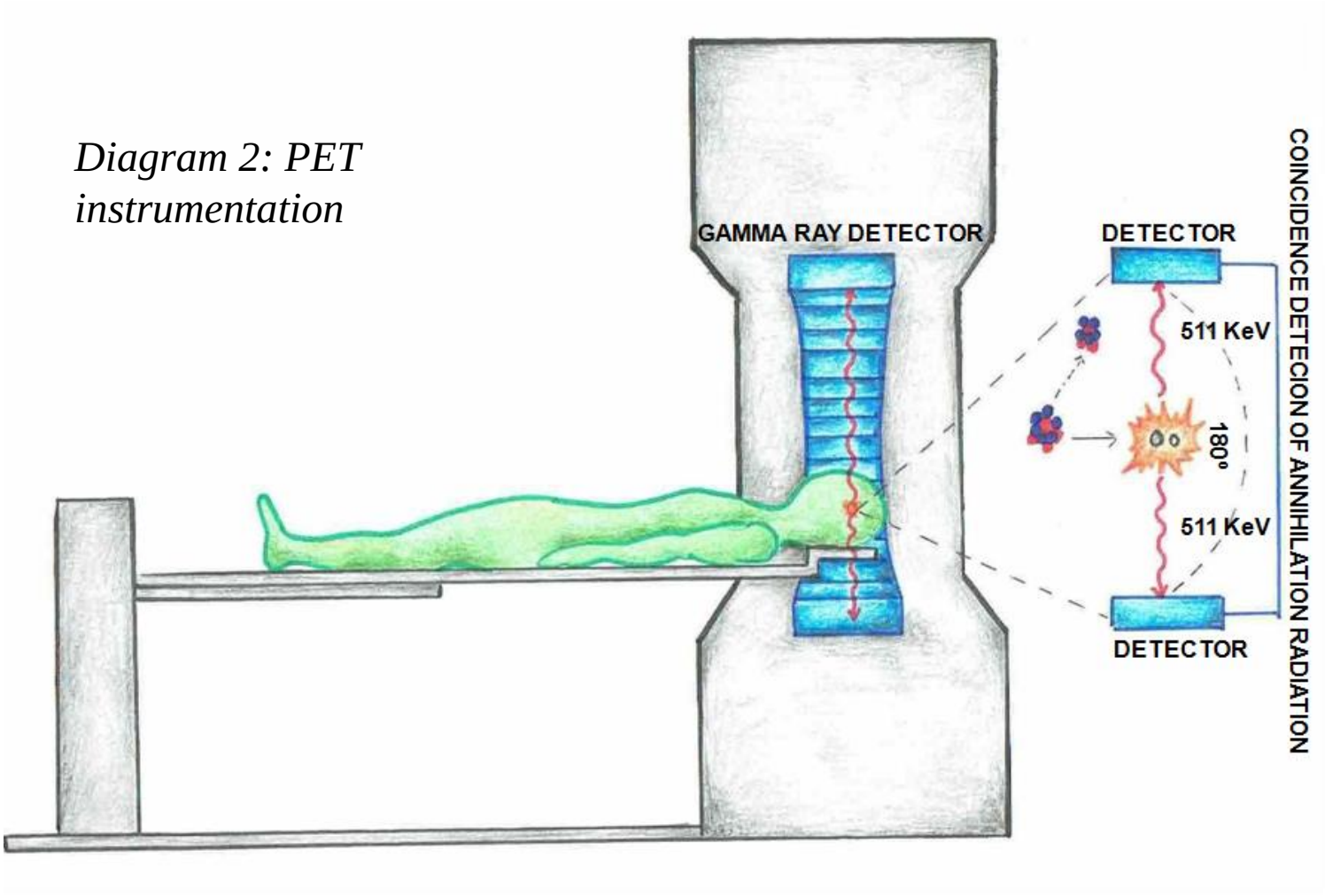
3.- An electron collides with a positron. The annihilated particles are replaced by energy (annihilation photons).

4.- Paired detectors located on opposite sides of the annihilation reaction register coincident photon impacts.

5.- Reconstruction of a medical image with the data collected.

3. PET image creation

Diagram 2: PET instrumentation



4. Advantages of PET use

Advantages of the use of Positron-emitting isotopes	Advantages of the use of annihilation coincidence detection
• Low radiation exposure for the patient • It makes possible to mark foreign or own molecules without lesion. • It permits the study of marked molecules *in vivo*. It's a noninvasive method.	• High sensibility and efficacy of detection. • The best spatial resolution (4mm on the three dimensions) • Field uniformity • Real correction of field attenuation • Quantitative analysis

5. Medical application of PET

5.1. Use in Oncology

1. **Differential diagnosis** between benign and malignant tumors.
2. **Staging.**
3. **Localization** of the optimal focus for a biopsy.
4. **Prediction** of the malignancy degree and prognosis.
5. **Treatment response evaluation**.
6. **Residual mass study**.
7. **Recurrence and radionecrosis differentiation**.
8. **Recurrence detection.**

Image 1: neuroendocrine metastases PET.

5. Medical application of PET

5.2.Use in Cardiology

Study of patients with **Coronary artery disease** for a possible intervention or angioplasty.

Necessary to

Improve

Determine the existence of viable myocardial and the probability of response to the treatment.

The patients' selection criteria and the probability of success of the intervention.

5. Medical application of PET

5.3.Use in Neurology

PET permits the knowledge of the biochemical bases and physiological processes of neurodegenerative and neuropsychiatric diseases.

- ✓ ***Alzheimer***:Early differential diagnosis of high reliability on minor or uncertain cases of the disease.
- ✓ ***Parkinson***:differential diagnosis and utility of the interventionist treatment of the disease.
- ✓ ***Epilepsia***:detection of the epileptogenic focus in the temporal lobe for the reintegration. This procedure is used when patients can't control their crisis with medication.

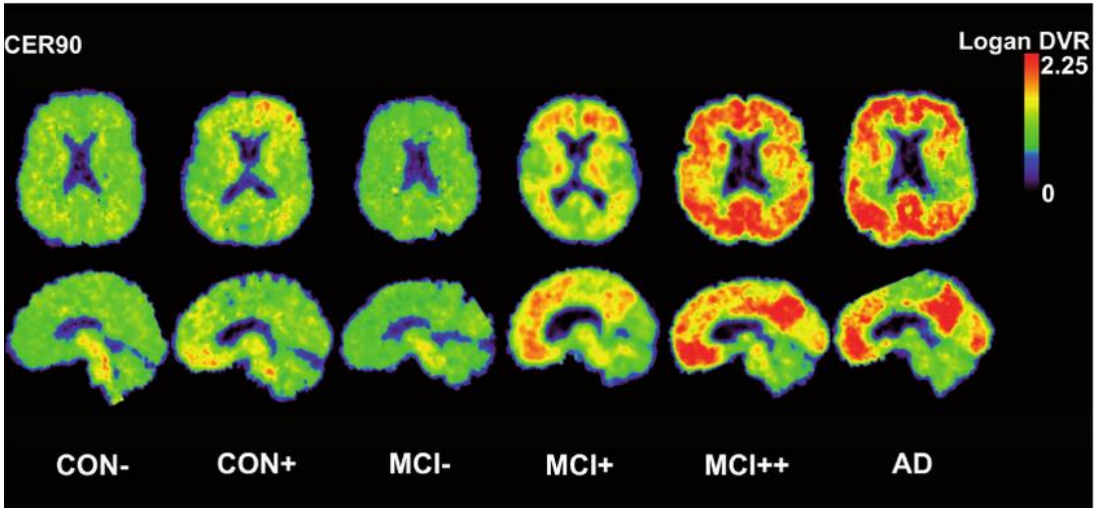


Image 2: Alzheimer PET spectre using [C] PiB

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- Cover image:

  Suetens, Paul. Fundamentals of Medical Imaging. Cambridge, GBR: Cambridge University Press, 2009. ProQuest ebrary. Web. 7 January 2016. Copyright © 2009. Cambridge University Press. All rights reserved.

- Images 1 y 2:

  Weissleder, Ralph, Ross, Brian D., and Rehemtulla, Alnawaz, eds. Molecular Imaging. Shelton, CT, USA: PMPH USA, Ltd., 2010. ProQuest ebrary. Web. 7 January 2016. Copyright © 2010. PMPH USA, Ltd.. All rights reserved.

- Diagrams 1 y 2:

  Realizados por *María del Pilar Garrido Ruiz.*