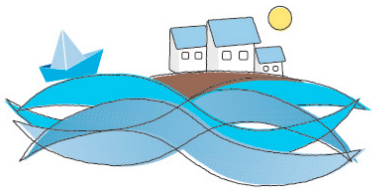

Mediterranean Thematic Workshops in Advanced Molecular Imaging

Contribution ID: **66** Type: **Invited**

The history of the first 70 years of PET and a vision for the next 10 years?

Wednesday 7 September 2022 14:00 (30 minutes)

Positron Emission Tomography (PET) is one the most used techniques in Medical Imaging. It originated from the synergic discovery of 5 scientists, all Nobel Laureates in three different fields of science (Physics, Chemistry, Physiology or Medicine), namely: Carl David Anderson (Nobel Laureate in Physics in 1936) "for his discovery of the positron"; Ernest Orlando Lawrence (Nobel Laureate in Physics in 1939) "for the invention and development of the cyclotron and for results obtained with it, especially with regard to artificial radioactive elements"; George de Hevesy (Nobel laureate in Chemistry in 1943) "for his work on the use of isotopes as tracers in the study of chemical processes"; Godfrey N. Hounsfield and Allan M. Cormack, (Nobel Laureates in Physiology or Medicine in 1979) "for the development of computer assisted tomography", that uses the same image reconstruction method as utilized by PET. It is notable that the first concept of a PET scanner was proposed by a neurosurgeon (William Sweet) as a device to localize a tumor in the left or right part of the brain. The preliminary idea was presented at the dedication of the Research Building of the Massachusetts General Hospital on May 16, 1951. More than 70 years have passed since then and a "plethora"of applications have been done and PET is an essential actor in the diagnosis, therapy and prognosis of many diseases.
This list of Nobel laureates outlines the 4 pillars of PET: the physics of the positron, the production of artificial radioisotopes, the use of the radiotracers to study the physiology and pathology of the human body, the 2-D, 3-D and 4-D reconstruction of the activity image within an organ, a system or the entire body. In this presentation, I will make an "on the flight"review of many applications, and some thoughts will be presented for the future.
I will try to cover the numerous PET applications from the initial studies of the physiology of brain, to tumor detection and tumor biology, to the contribution to treatment planning and particle therapy range monitoring. The evolution of the detectors (wire chambers, high Z and ultra-fast pixelated scintillators), phototubes and solid state photosensors, discrete and digital electronics, MLEM reconstruction algorithms and, more recently, Artificial Intelligences have well established the field of Molecular Imaging. The solid angle coverage of a PET scanner has already increased to almost 4 Pi, whereas Time-of -Flight PET (TOFPET) aims reaching 10 ps resolution.
The future for PET is challenging and promising at the same time. Further improvements are behind the corner: for instance, to couple PET to metabolic and metabolomic radiotracers; new information will be provided from hybrid system such as PET/MR or EEG/PET/MR coupled to AI, where the immediate "ms" response to electric stimuli will be combined with the "some s"response of fMRI and with the "several minutes" stationary information of PET. The split-gradient MR, already available for assisted MR radiotherapy, could provide the modern hardware scenario. Organ specific PET, especially for Breast and Brain, may become available at a reasonable cost and additional positron physics could be used such as Cherenkov imaging or three photon detection for appropriate radioisotopes. All in all, after 70 years on the scene PET is alive and kicking and will be a fundamental and truly interdisciplinary imaging technique of the "precision medicine" for years to come.

Topic Selection

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