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Editorial

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Nuclear Medicine in the Third Millennium

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The advent of extraordinary advances in the field of molecular and cellular biology have substantially modified both the diagnostic and therapeutic approaches of many human pathologies [1,2].

The ability to decode the entire human genome [3], as well as the identification of alterations and molecular genetic mechanisms underlying several diseases [4], or the ongoing identification of new molecular targets, have transformed our ability to identify many pathological processes making possible toset in on their evolution by monitoring them with properly synthesized radioactive molecules [5].

The future development in diagnostic and therapeutic field of Nuclear Medicine consists in validating innovative imaging methods whose purpose is to visualize and quantify in vivo complex cellular processes. Just think of processes such as angiogenesis, apoptosis, pleiotropic drug resistance and gene expression modulation, especially in their application in neoplastic diseases.

The possibility offered to nuclear medicine in this sense therefore allows it to be a primary protagonist in the development of the diagnosis and therapy of complex pathologies, including a series of rare diseases.

The development of new non-invasive and high-resolution imaging technologies, in conjunction with the design, synthesis and characterization of molecular probes directed against specific molecular targets [6] allowed the development of that large area of research called "molecular imaging", a technique that provides the tools for studying numerous biological processes both qualitatively and quantitatively, and non-invasively.

A role to play through the testing of new diagnostic methods capable of displaying the finest pathogenetic mechanisms, but also test the effectiveness of new therapies aimed at restoring a broken function. All this across the frontier not only of the world of "medical imaging" but also, and above all, of molecular biology and nanotechnology.

It is, therefore, currently easy to take advantage of the potential applications of Molecular Imaging obviously made possible Positron-emission tomography (PET), which has already partially solved the "intrinsic" limit of clinical research, i.e. to create "molecular images", bringing a pharmacological molecule, linked to a radionuclide, into the cellular structure.

The future of Nuclear Medicine is therefore an effective use of radioactivity, which allows us to get more and more into the mechanisms that generate and maintain the disease and eliminate them or, if possible, to correct them.

To achieve this, it is fundamental to characterize in vivo antigen/antibody, such as receptor/ligand systems and transport/substrate molecules, of which the current modalities of molecular imaging are present and future instruments.

The new millennium has opened with alarming data on infections and antimicrobial resistance. Viral infections (SARS, MERS-CoV, Zika, Chikungunya, West Nile, Ebola virus infection, etc.) emerged or re-emerged with threatening foci. Furthermore a new emergency consists in antimicrobial resistance to bacterial infections, which is an extremely important issue in developed and developing countries, where this problem has become a top priority for global policy makers and public health authorities [7] and nuclear medicine can offer valid answers in this area [8].

Speaking of training, it is to be considered that residents and consultants in radiology and nuclear medicine have a great interest in the further formation of mutual specialties [9].

A further impetus to the development of nuclear medicine lies in the conception, design and construction of ever more efficient hybrid machinesin order to provide more information with only one exam [10].

To keep in mind the advent of "artificial intelligence" in our branch, with some fear that makes us lose autonomy and visibility. But artificial intelligence will not destroy our specialty. Rather, it will work alongside us and make our specialty more relevant than ever in providing value-based cancer care [11].

More progress has been made in the field of nuclear medical therapy. In fact, the advent of new radiopharmaceuticals, and in particular alpha-emitters, resulted in the achievement of results before unexpected with very effective therapeutic action on neoplastic tissue accompanied by a negligible dose to healthy tissues [12].

These terapeutic advantages are even more enhanced by the development of increasingly precise and accurate dosimetry techniques [13] capable of evaluating the dose absorbed by the neoplastic tissue well before the administration of the therapeutic dose, through the application of the theranostic that sees in nuclear medicine its natural dead end [14,15].

I would like to conclude with the words of President Roosevelt, "the only thing we have to fear is fear itself". Fear is powerful, but rather than surrender to it, we can choose to create a future in which the members of our specialty are among the leaders in precision medicine and value-based healthcare.

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