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Shed a Light in the Darkness: Technology against Cancer

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Abstract

Far from the time when a simple candle light illuminated an optical microscope in an attempt to remove the veil of the unknown and fascinating world of biological phenomena, we now live in a world where stupendous research facilities are able to really shed some light through the world of functioning of life. Although the great discoveries have been carried out in the 50´s, with the solution of the DNA model, and the first protein (myoglobin) and enzyme (lysozyme) structures have been solved in the 60´s, thanks to the advent of these facilities, synchrotron radiation and neutron (reactors and spallation sources) laboratories, a huge input in the life science has allowed the scientists to reveal the mysterious of biochemical and biophysical processes of nature.

Discussion

Nowadays, more than a hundred thousand protein structures (five to nine thousand per year in the last decade) has been determined using the macromolecular crystallography (with X-ray and neutron sources) and helped the researchers to understand the complex circles of biochemical process inside the human body. Furthermore, these findings have assisted the scientific community to design drugs in order to attack specific diseases, including several types of cancer. Not just the protein crystallography, but the myriad of techniques, such as neutron and X-ray small angle scattering, circular dichroism, imaging techniques (X-ray and neutron tomography), infrared microspectroscopy and inelastic neutron scattering, are being used with the purpose of giving more details of the intricate biochemical and biophysical cellular processes, like the protein-protein and protein-lipid interaction, or the dynamical process of the drug in a specific solution against its target. Although it is necessary not just high initials investments to their implementations but also high maintenance costs, countries like Brazil, Argentina, South Africa, Australia, Russia, India and China, are aware of their importance in the technological advances to the improvement of the socioeconomic development, showing great interest in the construction of big facilities. The aim to overcome the challenges of scientific and technological development, we name Brazilian case, where investment has been made for the construction of two facilities for scientific development:

Brazilian Multipurpose Reactor - RMB and Light Synchrotron Laboratory - Sirius. In despite of economic difficulties hundreds of millions of dollar will be applied to support local and international scientific community.

In medical and pharmaceutical point of view, all these information are essentials in the development of new and efficient drugs to grapple with cancer and its complexity. Cancer cells present several strategies to escape from cell death, to develop invasive mechanisms, and to maintain a high proliferative rate, including the modulation of gene expression, up- and down-regulation of signaling pathways, among others. Continuous discoveries and comprehension of such alterations allows further advances in the understading of cancer biology, identification of molecular targets and improvement of cancer therapy. Therefore, the ways how to send the drugs to the right target inside the body are also required in order to get the maximum effectiveness and the minimum side effects to the patient with cancer. For this reason, the deepen of researches related to the "nanoworld" has enabled not only the elucidation of the structure of biological macromolecules, but also provided basis for the development of novel therapies using nanocarriers systems such as liposomes, cyclodextrins, nanocapsules, micelles, nanospheres, dendrimers, etc. In fact, the analysis of their supramolecular structure, the study of their interaction with drugs and/or other bioactive molecules has been accomplished through physico-chemical techniques, allowing the selection of the most appropriate systems for the targeted therapy. Therefore, the Nanotechnology applied to Chemistry, Pharmaceutical Technology, Pharmacology and Nanomedicine using drug-delivery systems allied to the use of the large facilities for their physico-chemical characterization will improve the methods of production of those systems in order to facilitate and optimize their action into the body.

Conclusion

We believe that, with all the efforts and new technologies developments, in a future, the war against cancer will be won, thanks to the coalition of the several physical, chemical and biological techniques, with the use of advancement of the powerful tools of technology. For the time being, we are overcoming the battles.