It is becoming a truism to state that the progress in computer technologies and nanotechnologies, biomedical imaging, and molecular biology has made it possible to switch from a population treatment approach to a concept based on personalized medicine [1]. The shift from population to individual patient treatment implies the use of information derived from different actors and disciplines which individually do not have the capacity to propose a comprehensive offer [2]. This is particularly true in the field of radiation and medical oncology as well as in clinical and molecular radiology. The main advantage of combining information derived from different clinical and preclinical fields lies in the possibility of selecting a specific population of subjects who, most likely, will benefit from a particular pharmacological or nonpharmacological treatment in accordance with their “molecular profile” at a given time-point [1, 2]. At the same time this information may conversely be used to select patients for whom the risk of adverse effects may be higher [1, 2].

Prostate cancer (Pca) is one of the most commonly diagnosed cancers in men and surgery [3] and radiotherapy (RT) [3–5] remain the gold standard for the treatment of localized or locally advanced Pca. Radiotherapy is configured as a powerful treatment approach with outstanding oncological results and with impressive technical improvements over the last two decades [6]. We now have a greater understanding of mechanisms sustaining the biological processes responsible for tumor progression [7–12] or towards a biological aggressive or radio resistant phenotype [13–15]. However, we are aware that the improvement in oncological outcome of men who remain at high risk for systemic failure may be achieved by improving each diagnostic and therapeutic step including the diagnostic performances of conventional imaging modalities [16]. To date, conventional anatomic imaging techniques of computed tomography (CT), ultrasound, magnetic resonance imaging (MRI), single-photon emission computed tomography (SPECT), and positron emission tomography (PET) are currently used in the common clinical practice to stage men suffering from Pca [17–20]. All these diagnostic tools have peculiar advantages and disadvantages although they play a rather limited role in monitoring men with Pca [17–20]. These limitations are attributable to the incapacity to distinguish malignant from the surrounding nonmalignant tissue [16–20]. The close integration between molecular biology and clinical imaging may ease the development of new molecular imaging agents useful in monitoring a number of biological events that, until a few years ago, were studied by conventional molecular assays [17]. With regard to Pca, progress in quantification, characterization, and timing of biological processes may be obtained overcoming problems related to the amplification of low level signals of in vivo biological events, the development of integrated imaging platforms with sufficiently high spatial and temporal resolution [18], and the need to reach the target in vivo to achieve satisfactory specificity [16–20].

The advances in the molecular based approaches in radiology are specifically evident in oncological treatments [19]. One of the most striking examples of foregoing statements is attested by the development of the enormous amount...
of specific drugs and inhibitors, the ability to genetically modify cellular systems, and the introduction of a multitude of diagnostic tools able to monitor individual molecular and biological processes [17]. These achievements have dramatically augmented our understanding of molecular oncology and this body of knowledge can now be translated into new drugs or agents for molecular imaging by allowing detection of patients with specific molecular profiles and improving patient care [20].

Finally a significant advance has been achieved with the theranostics which represents a research field integrating two distinct approaches that both encompass all steps of patients' management [21–23]. Of course, medical imaging is the prerequisite for such approach. However, the other mainstay of this approach is the use of molecular biomarkers which are important in the diagnostic processes, in determining the best course of treatment, in monitoring the patient's response and in detecting potential recurrence of the disease, and in anticipating potential adverse effects. Basically, theranostics has three distinct fields of application. They include (1) selection of patients for a specific treatment, (2) the prediction for drug response, resistance, and safety, and (3) monitoring of the therapeutic response [21–23].


Authors’ Contribution

Lorenzo Livi and Andrea M. Isidori equally contributed to this paper.

Acknowledgment

We would like to thank all authors who contributed to this special issue for their excellent work and we hope that this issue will be useful to the experts of all profiles dealing with prostate cancer in both clinical and preclinical settings.

Lorenzo Livi
Andrea M. Isidori
David Sherris
Giovanni Luca Gravina

References


Submit your manuscripts at
http://www.hindawi.com