LOCOREGIONAL CHEMORADIOTHERAPY OF CANCER USING HYDROGEL

David J. Yang, Ali Azhdarinia, Hiroaki Kurihara, Jerry Bryant, and E. Edmund Kim
Division of Diagnostic Imaging, The University of Texas M.D. Anderson Cancer Center, Houston, Texas

1 INTRODUCTION

1.1 Values of Molecular Imaging in Cancer Treatment

Drug discovery and development are accelerating due to rapid synthesis of potential drugs and development of high-throughput in vitro tests. The development of radiolabeled biochemical compounds and imaging devices to detect the radioactivity by external imaging has expanded the use of nuclear medicine studies in drug development. Agents developed for positron emission tomography (PET) and single photon emission computed tomography (SPECT) are molecular imaging agents because they can characterize the disease. Since molecular imaging plays a major role in drug development because of its ability to quantify drug properties in vivo, it is beginning to be used in all phases of drug discovery and development. PET and SPECT agents show high specific activities because they are made through a nuclear transformation and use carrier-free forms of isotopes. PET and SPECT agents do not produce detectable pharmacologic effects but provide important information concerning the characterization of varieties of tumors (vascular angiogenesis, hypoxia, apoptosis, cellular signaling, and transcriptional activity) [1–8]. Computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound are prognostic tools because they do not provide cellular target information. Thus, assessment of the effectiveness of cancer therapy is not optimal. However, combining the anatomical and morphological location from CT, PET/CT and SPECT/CT are able to accurately evaluate posttherapy anatomic alteration. In addition, PET and SPECT agents may assist in the determination of optimal therapeutic dosing, differential diagnosis between inflammation/infection and recurrence, sensitive or resistant to treatment response, grading of tumors, and the prediction of treatment response by selecting patients who may respond to therapy.

1.2 Radiotheranostic Isotopes for Image-Guided Locoregional Chemoradiotherapy

Radiation therapy (XRT) is a form of cancer treatment that uses ionizing radiation to destroy cancer cells. Roughly 60% of all cancer patients receive XRT for multiple cancers including lung, breast, prostate, and head and neck. XRT can be delivered via external beams (photon, proton, neutron, and boron–neutron capture therapy) or internally using brachytherapy seeds. Conventional external beam radiation plays a limited role in the management of patients with certain nonresectable tumors because the maximum tumor dose is limited by the normal tissue tolerance [9]. Internal radiation therapy (IRT) with iodine-125 (^{125}I) (150 keV β emission, $t_{1/2} = 59.4$ days) brachytherapy seeds are the preferred method for localized prostate cancer treatment. However, several drawbacks exist with such a procedure. First, brachytherapy seeds can only be used once and the procedure cannot be repeated

Pharmaceutical Sciences Encyclopedia: Drug Discovery, Development, and Manufacturing
Edited by Shayne C. Gad