RADIOPHARMACEUTICALS AND MEDICAL IMAGING: DEVELOPMENT OF RADIOIMMUMOCONJUGATES FOR RADIOIMMUNOIMAGING AND RADIOIMMUNOTHERAPY OF MALIGNANT DISEASES

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1 INTRODUCTION

Radioisotopes have been applied to detect and treat malignant diseases for a long time. Radiopharmaceuticals are generally classified as either being diagnostic or therapeutic according to their application. As shown in Figure 1, a radiopharmaceutical can be considered to have three components: (i) the targeting carrier, (ii) the radionuclide, and (iii) a linker moiety [1]. A perfect radiopharmaceutical would, after intravenous administration, travel via the bloodstream to the target cells, where it would efficiently bind only with cell surface or intracellular counterparts or interact solely with the desired molecular pathway. Any radioligand that did not reach the desired target would be rapidly excreted from the body so that the only radioactivity remaining in the body would be that localized to the target site. The development of radiopharmaceuticals has followed closely behind the advances made by the relevant disciplines such as particle physics, chemistry, radiochemistry, radiopharmacy, and biology. Radioimmunopharmaceuticals or radioimmunoconjugates (RICs) are using antibody (Ab) or antibody derivatives as targeting carriers, taking advantage of the specific binding between antibody and antigen. In this chapter, we will discuss several aspects of RIC development and their application in radioimmunoimaging (RII) and radioimmunotherapy (RIT) for malignant diseases, including lymphoma, prostate cancer, colon cancer, and breast and ovarian cancers.

2 RADIONUCLIDES

Radionuclides function as beacons in RII and killing agents in RIT. For imaging purpose, γ-ray and positron emitters will be used, while β-particle emitters, α-particle emitters, and Auger and Coster-Kronig electron emitters will be considered for RIT. A number of factors need to be considered when selecting appropriate radionuclides for RII and RIT, including emission characteristics, physical half-life, cost, availability, and linkage chemistry. The radionuclides evaluated in preclinical and clinical RII and RIT studies have been summarized in several reviews [1, 2].

As one of the predominant factors for determining a radionuclide's suitability for RII and RIT, the physical half-life should be comparable to the time needed for

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