

The Promise and Challenges in Developing Alpha-Emitting Radiopharmaceuticals

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The decay properties of alpha-emitting radionuclides make them very attractive for use in therapy of cancers, particularly blood-borne and disseminated cancers. However, there are many challenges that have to be overcome to realize that therapeutic potential. One of the challenges is societal acceptance. This was brought about in part by inappropriate use of alpha-emitting radionuclides. Following the discovery of radioactive elements in the 1890's it was only a short period of time before radium was used for treatment of cancer patients. Unfortunately, clinical trials were non-existent at that time and development of dosages and therapeutic regimens did not exist. Additionally, the early belief that radium had healing powers, along with its unrestricted commercial availability, led to marketing of products containing radium that were inappropriately used for wide spectrum of human problems. This led to disastrous results and generated the impression that radioactive materials, particularly alpha-emitters, were bad for society. Even with this impression, it is perhaps the technical challenges that have been the largest hurdle in development of radiopharmaceuticals containing alpha-emitting radionuclides. Although nature has provided a number of alpha-emitting radionuclides, because of their decay properties and daughter nuclides, there are only 10 that are considered appropriate for use in radiopharmaceuticals. The general lack of availability of those alpha-emitting radionuclides has severely limited the development of radiopharmaceuticals. It has led to difficulties in understanding the chemistry associated with the radionuclides, which in turn has made it difficult to develop methods for stably attaching them to cancer targeting agents. This presentation will provide an overview of the history, properties and radionuclides of interest for developing radiopharmaceuticals containing alpha-emitting radionuclides. Challenges that have been addressed in developing radiopharmaceuticals containing the alpha-emitting radionuclide astatine-211 will be highlighted.