Nanoparticles for Molecular Imaging of Cancer

Bulent Aydogan
Department of Radiation and Cellular Oncology
Director of Medical Physics at UIC
Committee on Medical Physics
Cancer Research Center
The University of Chicago
5758 S. Maryland Ave
Chicago, IL 60637
baydogan@radonc.uchicago.edu

Functional CT technique offers a new set of capabilities in cancer imaging by providing unmatched high-resolution anatomic and functional images in a single CT scan. However, due to lack of suitable contrast agents, functional CT imaging of cancer has not been successful. We investigate the feasibility of using 2-Deoxy-D-Glucose (2-DG) labeled gold nanoparticle (AuNP-2-DG) as functionally targeted CT contrast agent to obtain high resolution metabolic and anatomic information of tumors in a single CT scan. Gold nanoparticles (AuNP) were fabricated and conjugated with 1- or 2-Deoxy-D-Glucose. 1-DG provides an excellent comparison since it is known to interfere with the ability of the glucose transporter to recognize the sugar moiety. The human alveolar epithelial cancer cell line, A-549, was chosen for the in vitro cellular uptake assay. Three groups of cell samples were incubated with the 1-DG or 2-DG labeled AuNP and the unlabeled AuNP. The cell pellets were imaged using a microCT scanner immediately after the centrifugation. Internalization of AuNP-2-DG is verified using Transmission Electron Microscopy imaging. Three to four fold contrast enhancement was observed in the cell samples incubated with the AuNP-2-DG with respect to the cell samples incubated with the unlabeled AuNP and the AuNP-1-DG. In addition, our preliminary in vivo experiments were very encouraging. Results from our in vitro and preliminary in vivo experiments suggest that AuNP-2-DG may be used as a functional CT contrast agent to provide high-resolution metabolic and anatomic information in a single CT scan. Successful clinical implementation of this technique may be expected to greatly improve the accuracy of target definition and radiation delivery in modern radiotherapy.

ACKNOWLEDGMENTS

This work was partially supported by Research Training in Medical Physics 5 T32-EB002103-19 and ACS, Illinois 160356. Use of the Center for Nanoscale Materials at Argonne National Laboratory was supported by the U.S. Department of Energy, Office of Science, Office of Basic Energy Science, under Contract No. DE-AC02-06CH11357.