The Sixth Conference on Radioimmunodetection and Radioimmunotherapy of Cancer

Abstract Form

October 10-12, 1996, Princeton Marriott, Princeton, NJ

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June 1, 1996

SUBJECT

- ☐ Radiochemistry
- ☒ Physics and Dosimetry
- ☐ Radiation Biology
- ☐ Experimental Targeting
- ☐ Clinical Radioimmunodetection
- ☐ Experimental Radioimmunotherapy, Including Pretargeting
- ☐ Clinical Radioimmunotherapy
- ☐ Reengineering of Monoclonal Antibodies
- ☐ Diverse

PREFERENCE

- ☐ Oral Presentation
- ☐ Poster
- ☒ No Preference (either)

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POTENTIALLY-MARKER-FREE REGISTRATION OF CT WITH I-131 ANTI-B1 MONOCLONAL-ANTIBODY INTRA-THERAPY SPECT. K.F. Koral, S.Lin, J.A. Fessler~, M.S. Kaminski, R.L. Wahl, C.R. Meyer*, J.L. Boes*, B. Kim* and P.H. Bland*. Departments of Internal Medicine, Electrical Engineering and Computer Science~ and Radiology* at the University of Michigan Medical Center, Ann Arbor, MI 48109-0552.

In treatment of non-Hodgkin's lymphoma patients with predose-plus-I-131-labeled anti-B1 (anti-CD20) monoclonal antibody, an intra-therapy SPECT image is an important part of research estimates of tumor dosimetry. For that imaging, a CT-SPECT fusion is employed both to obtain an attenuation map for the space-alternating generalized EM (SAGE) reconstruction and also to provide CT-based volumes of interest to determine activity in tumors and organs. Fusion based on external, skin-surface markers has been employed (J Nucl Med 1994; 35:1714-1720), but it may not correctly superimpose internal structures. A new algorithm, developed and implemented in the Department of Radiology and based on the mutual information of geometrically-mapped, gray-scale values, is investigated in this research. In our present implementation, we initially use FBP reconstruction without attenuation correction to obtain the position of five markers. We then carry out marker-based fusion of CT images into the SPECT space to obtain the basis for the attenuation map. The original SPECT projection data is then reconstructed again using the SAGE algorithm plus the maps. Finally those reconstructions are transformed into CT space by the new mutual-information algorithm. We use the algorithm in a mode that specifies warp-free three-dimensional translation and rotation with the scale set by the known voxel size in each modality. For comparison, this last transformation is also carried out by the marker method. Finally, volumes of interest (VoI) are drawn on the CT images and applied to the final results from both fusion methods. The counts obtained for both kidneys and two tumors for a typical patient imaged 4 days after the therapy administration are compared below.

The left and right kidney have 3.2 and 9.6% more counts, respectively, with the new registration indicating that the VoI are more accurately placed over the true, higher-activity location of those organs. The counts for a larger and a smaller tumor change by +4.0 and -7.2%. Here, the correct answer is unknown but these final answers are not the same with the new algorithm and so activity estimates might be more accurate. Although markers were placed and utilized for this patient, the initial fusion can probably be carried out with the new algorithm. Also, the actual presence of the small markers is likely unnecessary for the functioning of that algorithm. Verification of these points is under current investigation.

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absorbed dose or with BM absorbed dose estimates does not show any further improvement over correlation with total radioactivity administered. Patient variability, including increased radiation sensitivity from prior myelosuppressive therapy have reduced the value of these dose estimations for predicting toxicity. A prior therapy index must be added to the equations to improve the clinical utility of the BM dose estimates.

75. POTENTIALLY-MARKER-FREE REGISTRATION OF CT WITH I-131 ANTI-B1 MONOCLONAL-ANTIBODY INTRA-THERAPY SPECT.

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76. THE EFFECT OF 3-D ACTIVITY DISTRIBUTION IN DOSE PLANNING OF RADIOIMMUNOTHERAPY.

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A treatment planning software has been developed where functional information obtained from SPECT is integrated with anatomical information from CT. The activity distribution from SPECT is converted to absorbed dose distributions using a point kernel convolution dose calculation.

The described software requires as input activity concentration maps from functional images. The activity images have been corrected for scatter and attenuation to obtain quantitative SPECT images. The images are registered with diagnostic CT images. The dose calculations require a radionuclide specific absorbed dose point kernel. The dose point kernel specifies the absorbed dose as a function of distance and can be obtained for example from Monte Carlo simulations. Absorbed dose distributions are calculated using the point kernels and activity maps from the quantitative SPECT images. The activity map is divided in to equally sized source voxels from which the distribution is calculated to the target voxels which cover the patient volume. The resulting three dimensional dose distribution is viewed as isodose contours superimposed on the CT study. The