

From the SNM MIRD Committee

The mission of the SNM Medical Internal Radiation Dose (MIRD) Committee is to develop standard methods, models, and mathematical schema for assessing internal radiation dose from administered radiopharmaceuticals. Some of the objectives are to provide basic tools, methods, and guidance for effective application of dosimetry techniques in clinical practice. In the course of pursuing these goals, the MIRD Committee builds on the latest advances in molecular medicine, radiopharmaceutical design, and imaging instrumentation.

In 2007, committee activities were focused in the following areas: (1) completion of the radionuclide data and decay scheme book for use by investigators in diagnostic and molecular therapeutics (publication set for 2008); (2) generation of electron and photon absorbed fractions for updated and more realistic anatomical phantoms; (3) assessment of the dosimetric implications of α -particle emitters as molecular therapeutic agents; (4) evaluation of the role of individualized (patient-specific) dosimetry for radionuclide therapy; (5) development of a formalism for incorporating radiobiologic effects into dosimetry models to enable a better understanding of the correlation between absorbed dose and biological response; (6) extension of S values and phantom models to the voxel level; and (7) finalization of a dose estimate report for a therapeutic radionuclide-antibody conjugate. The educational component of the MIRD Committee activities is directed toward sponsoring continuing education courses on emerging topics of interest in dosimetry at the SNM annual meetings. In addition, the committee has served as a coorganizer of the International Symposia on Radionuclide Therapy and Radiopharmaceutical Dosimetry (ISRTRD) and will function as the host of the 3rd ISRTRD to be held in conjunction with the 2009 SNM Annual Meeting in Toronto, Canada.

The major publication project brought to completion in 2007 was the revised edition of the *MIRD Radionuclide Data and Decay Schemes* monograph originally published in 1989 (1) but now out of print. This revision provides tabulated energies and intensities of radiations emitted in the decay of 333 radionuclides of relevance in diagnostic and therapeutic molecular medicine. The work was carried out in collaboration between Oak Ridge National Laboratory (ORNL) (Keith F. Eckerman, PhD) and the Japan Atomic Energy Research Institute (Akira Endo, PhD). The new edition includes 91 radionuclides that were not addressed in the earlier edition, reflecting additional radionuclides that are either currently in use or offer promise for future use in molecular medicine. Accompanying this edition is a CD that provides access to the β spectra, tabulated decay data, decay schemes, and other data in an electronic format. The target audiences for this book include physicians, chemists, physicists, and other professionals with an interest in having a primary reference

source for physical data on radionuclides of relevance to nuclear medicine. Distribution of this monograph is scheduled to take place in the second half of 2008.

Within the MIRD Committee, task groups are engaged in preparing a number of publications that are expected to be available in 2008. A monograph on *Absorbed Fractions for Photon and Electron Sources* will provide a revised series of phantoms (adult, pediatric, and pregnant women computational models) incorporating modifications to the existing ORNL series. Monte Carlo transport simulations have been carried out for both photons and electrons from which tables of absorbed fractions and specific absorbed fractions have been generated. Another project representing an update to MIRD Pamphlet 17 (2) has been directed at defining computationally efficient methods for dose calculations in heterogeneous activity distributions using fine-resolution voxel S values. This latter project has the potential to evolve as a tool that may be accessed from the MIRD SNM Web page. These efforts have been led by Wesley Bolch, PhD, and his group at the University of Florida.

The potential for α -particle-emitting radionuclides to play a role in the treatment of cancer has been recognized for a long time, but opportunities offered have not been realized because of technical challenges. Now, the latest advances in the targeted delivery of radionuclides, in radionuclide conjugation chemistry, and in the increased availability of α -emitters appropriate for clinical use have led to recent patient trials of α -emitter-labeled antibodies. Addressing this emerging field, a task group under the leadership of George Sgouros, PhD, has developed a MIRD report on dosimetry and human use of α -particle emitters for targeted radionuclide therapy that should be completed in 2008. The objectives are to review those aspects of the field that are pertinent to targeted α -particle emitter therapy and to provide guidance and recommendations for human α -particle emitter dosimetry.

The importance of dosimetry in radionuclide therapy treatment planning has been recognized by many investigators; however, dosimetry-based treatment planning has not been widely adopted in clinical practice. A MIRD commentary being prepared by Dr. Sgouros is directed at changing the perception of those who feel that dosimetry for radionuclide therapy adds cost without providing benefit. The commentary will review and highlight cases in which dose-response relationships have been demonstrated successfully following implementation of individualized (patient-specific), dosimetry-based treatment planning approaches. Through the examples cited, this commentary provides evidence that individualized



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dosimetry has value in predicting response and/or toxicity in patients.

Correlation of radiation dose in normal tissues with predicted and reported organ response remains an important area of investigation. Generating models and tools to assess this correlation for both uniform and nonuniform distributions of radioactivity in organs represents a critical ongoing endeavor. A task group chaired by Barry Wessels, PhD, is preparing a MIRD pamphlet on *The Effect of Model Assumptions on Kidney Dosimetry: Implications for Radionuclide Therapy*. With the advent of aggressive therapeutic strategies for cancer treatment using targeted radionuclide therapy, reports have appeared in the literature documenting significant renal impairment or failure. Use of available data in conjunction with the MIRD multiregion kidney model (3) opens the possibility of applying radiobiological analyses (e.g., dose rate, repair time of sublethal damage, and differential suborgan radiosensitivity) to better understand and predict renal toxicity.

Two other documents under preparation and in line as potential MIRD publications are: (1) a dose estimate report for ^{90}Y -ibritumomab tiuxetan using extensive quantitative imaging data from 10 non-Hodgkin's lymphoma patients from 3 institutions; and (2) revision and expansion of the MIRD schema designed to update and standardize terminology used in dosimetry calculations.

Each year, the MIRD Committee sponsors continuing education courses at the SNM Annual Meeting. In 2007, 2 sessions organized by Michael Stabin, PhD, addressed basic internal dosimetry methods in nuclear medicine and included topics on image quantification for dosimetry, patient-specific dose calculations for therapy patients, clinical use of radiation dosimetry, and participation by the U.S. Food and Drug Administration regarding aspects of dosimetry requirements in clinical trials. As an update on the previous year's sessions, the theme topic of the 2006 MIRD refresher courses was published in *The Journal of Nuclear Medicine* as "MIRD Continuing Education: Bystander and low-dose-rate effects: are these relevant to radionuclide therapy?" (4). The program for 2008 will address uncertainties in internal dosimetry, with 1 session focused on image quantification and the other on dosimetry and response.

The MIRD Committee presents the Loevinger-Berman Award annually in recognition of excellence pertaining to the field of internal dosimetry as it relates to nuclear medicine through: (1) research and/or development; (2) significant publication contributions; or (3) advancement of the understanding of internal dosimetry in relationship to risk and therapeutic efficacy. The 2007 Loevinger-Berman Award was presented to Evelyn Watson at the annual meeting in Washington, DC. Ms. Watson was honored for her leadership role and contributions to the MIRD Committee (serving as chair from 1994 to 2006) and the Radiation Internal Dose Information Center at the Oak Ridge Associated Universities, Oak Ridge Institute of Science and Education, in Tennessee.

The MIRD Committee is pleased to announce that the 3rd ISRTD and the Workshop on Alpha-Emitting Radionuclides in Therapy will convene in conjunction with the 2009 SNM Annual Meeting in Toronto, Canada (June 13–17, 2009). The SNM leadership and Scientific Program Committee enthusiastically supported the request of the MIRD Committee to hold this symposium in tandem with the SNM Annual Meeting. This symposium, which follows successful international symposia in Helsinki (2004) and Athens (2006), will be organized by the MIRD Committee together with representatives of the Dosimetry and Therapy committees of the European Association of Nuclear Medicine (EANM) and the European Commission, Joint Research Centre, Institute for Transuranium Elements (Karlsruhe, Germany). The 2009 Symposium and Workshop will blend with the SNM sessions in oncology, radiopharmaceutical chemistry, radiobiology, and dosimetry. The workshop will highlight current progress in the use of α -emitters for cancer therapy. Symposium topics will include: data collection and quantitative imaging, biodistribution and pharmacokinetics, clinical dosimetry and treatment planning, α -emitters in cancer therapy, Auger electron emitters, radiobiological studies, therapy of skeletal metastases, and bone pain palliation. Additional information during the preliminary planning stages may be obtained from: Dr. Sgouros, Vice-Chair, SNM MIRD Committee (sgouros@jhmi.edu) or Michael Lassmann, PhD, Chair, EANM Dosimetry Committee (Lassmann_M@Klinik.uni-wuerzburg.de).

The MIRD Committee welcomes the opportunity to continue in its role as a resource for SNM on issues involving dosimetry of internal emitters. This has particular importance as our society initiates strategies for advancing molecular imaging and molecular therapeutics in support of the diagnostic and therapeutic applications of radionuclides within medicine.

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