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Activity standardizations of pure-beta-emitting endovascular brachytherapy sources by liquid-scintillation-spectrometry-based destructive radionuclidic assays

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Abstract

Extensive investigations by the cardiology and radiation oncology research communities are currently underway to evaluate the use and efficacy of pure-beta-emitting endovascular brachytherapy sources for the prophylactic inhibition of restenosis following balloon angioplasty in heart-disease patients. Various manufacturers have developed sources in different dose-delivery configurations with several high-energy beta-emitting nuclides for this purpose. Three different types of sources have been assayed for activity to establish NIST-based calibrations. The sources are: *(i)* a TiNi-encapsulated ^{32}P seed having a highly-inert polymeric core; *(ii)* a stainless-steel-jacketed ^{90}Sr-^{90}Y source with a highly-refractory ceramic-like matrix; and *(iii)* a "hot wall" balloon catheter source that consists of a thin film of ^{32}P enveloped between the polyethylene balloon walls. The assays were performed by radiochemical digestion followed by liquid scintillation spectrometry of the resulting solutions. Novel methods have been devised to account for any residual activities in the digested sources and apparatus used for the assays. Initial ionization current measurements on the sources prior to the destructive assays led to the establishment of calibration factors that can be used for subsequent non-destructive measurements of similar sources. The destructive assays were also required to link Monte-Carlo-based theoretic modeling of the absorbed dose spatial distributions to radiochromic-film dosimetric measurements.

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About the speaker

Dr. Collé

currently serves as a Research Chemist in the Radioactivity Group of the NIST Physics Laboratory (Ionizing Radiation Division) and has worked in radionuclidic metrology at NIST since 1974. Some of his activities at NIST have included: developing and establishing the first national standards and measurement proficiency testing program for the North American radiopharmaceutical industry; developing and implementing national guidance for the reporting of environmental radiation measurements data; developing international conventions for the treatment of measurement uncertainties; establishing and coordinating measurement assurance programs for various ionizing radiation measurement applications; preparing and calibrating radioactivity standard reference materials; having primary responsibility for maintaining the national standards for radon-222 and radium-226, and developing new transfer standards and measurement methodologies for them; utilizing liquid scintillation spectrometry techniques for radionuclidic standardizations, including systematic studies of cocktail composition effects; and most recently, performing primary activity calibrations of sealed brachytherapy sources by destructive radiochemical digestions. Prior to his NIST career, he held research positions at Brookhaven National Laboratory, the State University of New York at Albany, and the University of Maryland where he conducted low- and medium-energy accelerator-based studies of atomic structure (inner-shell ionization phenomena) and nuclear reaction systematics, all of which were on radiochemical and nuclear chemistry approaches. He received a B.S. in Chemistry from the Georgia Institute of Technology (Atlanta, GA) in 1969, a Ph.D. in Chemistry (Nuclear and Radiochemistry) from Rensselaer Polytechnic Institute (Troy, NY) in 1972, and a M.S. Adm. (Administration of Science and Technology) from George Washington University in 1979.