The American Board of Radiology: MOC

Medical Nuclear Physics SDEP

Example 1: Regulatory Example 2: Technique Example 3: Research

Example 1: Regulatory

- Title: Patient Release Options and Considerations Following I-131 Therapy for Thyroid Cancer
- Category: Nuclear Medicine Regulations and Procedures
- Date Initiated:
- Date Completed:

A. Significance:

The revised Code of Federal Regulations 10CFR35.75 (1997) has provided greater latitude in the management of outpatients following therapeutic administration of radiopharmaceuticals. The previous rule requiring hospitalization if the activity in the patient exceeded 30 mCi was replaced with an exposure-based criterion for release (total effective dose to another individual from exposure to the released patient should be not likely to exceed 5 mSv or 500 mrem). The NRC regulatory guide specifies three options that may be used to determine release criteria that are based on 1) administered activity, 2) measured dose rate, and 3) patient-specific calculations. Critical analysis has pointed out the overly conservative nature of these methods due to use of 1) the point- source methodology, and 2) the measured surface dose rate to determine the whole-body dose (i.e., no consideration of tissue attenuation). Currently, for thyroid cancer patients who have received I-131 therapy, my institution has been utilizing the first (simplistic) option involving administered activity. The objective of this SDEP is to evaluate the other options with the intent of determining whether or not benefits would be achieved for both patients and the institution by implementation of a revised protocol utilizing other criteria.

B. Approach:

Reference articles on patient release following administration of radiopharmaceuticals will be identified and assembled. This will include, as the basis document, the NRC Regulatory Guide 8.39 on release of patients administered radioactive materials. These articles will be reviewed, and a flow chart describing the various options available will be developed. Specific example calculations will be provided for each. A series of 10 patients from our institution who have received I-131 therapy for thyroid cancer or remnant ablation will be evaluated (on a scenario basis) as if they had undergone the other options for patient release. The scenario calculations and outcomes will be compared with the current situation in which release is based on the administered activity and possibly physical decay. Discussions will be held with physicians and administrators as to the significance of the findings and whether or not one of the other options should be adopted.

C. Evaluation of Achievement:

1. PROSPECTIVE STATEMENT (provided at the date SDEP is initiated):

Midway through the project, a flow chart will have been developed presenting specific examples of the

various options. The workup will include a critical comparison of the methods detailing assumptions made in each and outlining various aspects and considerations per discussion points raised in the literature, and in personal observations. A final analysis of the 10-patient scenario study will be made, with a statement formulated on the comparative outcomes that would be expected for each patient under the different options.

2. FINAL STATEMENT (provided at the date SDEP is completed):

A comprehensive overview of the options for patient release following I-131 therapy for thyroid cancer and remnant ablation was developed. An extensive reference list was compiled, with summary statements on the strengths and weaknesses of each approach and with the conclusions of various authors. A full understanding of the necessary and sufficient documentation/ record-keeping required on the part of the institution if implementing other options was obtained. Twelve patients from our institution were worked up within a scenario setting as a comparative estimate of outcomes and management procedures for the various options. With the appropriate approvals obtained, exposure rates from these patients following administration of therapeutic I-131 and at some sequential points were measured for input into the scenario calculations. The significance of the findings was discussed with nuclear medicine physicians and administrators.

- D. Impact on Practice/Outcome Statement:

1. PROSPECTIVE STATEMENT (provided at the date SDEP is initiated):

The conclusions reached at the completion of this SDEP may have direct benefit on patient management by potentially enabling a reduction in the length of hospital stay. However, the documentation and record keeping required for the various options must be fully understood and evaluated as to realities of implementation and efficacy. At the very least, the institution will have benefited through direct investigation of the patient release options to confirm the protocol most appropriate for use.

2. FINAL STATEMENT (provided at the date SDEP is completed):

The institution has benefited in a general way through achieving a full understanding of the consequences of implementing various protocols for patient release following I-131 therapy. The comparative evaluation of patient release options indicated that significant reduction in patient hospitalization could be achieved using measured dose rate or patient-specific calculations rather than the current protocol of administered activity, according to the NRC Regulatory Guide 8.39 table specified value (1.2 GBq or 33 mCi for I-131). The reduction factor in hospital stay observed for the measured dose-rate method is related to patient attenuation effects that are not built into the NRC tables. This measurement procedure, documentation and record keeping are relatively straightforward and manageable. However, the patient-specific calculations are more involved, requiring extended allocation of personnel and resources. Thus, our institution has made the decision to modify patient-release policy and adopt the protocol based on direct patient dose-rate measurement.

Example 2: Techniques

- Title: Iterative Reconstruction Algorithms for SPECT Imaging
- Category: Nuclear Medicine Techniques
- Date Initiated:

Date Completed:

A. Significance:

In nuclear medicine, the traditional method for reconstruction of SPECT images has been filtered back projection (FBP). Limitations to FBP methods affect image quality, including problems associated with noise propagation, streak artifacts, and inefficient incorporation of attenuation correction. Affordable, high-capacity computer power and implementation of the more versatile iterative techniques such as maximum likelihood expectation maximization (MLEM) and ordered subset expectation maximization (OSEM) that can overcome these deficiencies have become practical and are replacing the FBP methods in clinical practice. This SDEP is intended to update understanding and general knowledge concerning the application principles and clinical advantages of iterative reconstruction techniques for SPECT imaging.

B. Approach:

Reference articles on iterative reconstruction techniques for SPECT imaging will be identified through a web-based literature search. These articles will be reviewed and catalogued by a) the technical aspects of the algorithms (i.e., how they work); and b) the clinical impact of improved image quality (i.e., performance evaluation). Comparison with traditional FBP reconstruction will be made whenever possible. In addition, contact will be made with basic scientists and technical personnel within commercial companies for the purpose of understanding specific, practical implementation of the iterative algorithms in clinical instrumentation.

C. Evaluation of Achievement:

1. PROSPECTIVE STATEMENT (provided at the date SDEP is initiated):

On completion of the project, an iterative reconstruction file for SPECT will have been assembled. It will contain reference articles, other relevant/associated source material, summary notes concerning these references, and notes describing contacts made with commercial companies. This file will document the learning process followed and will represent the knowledge gained in bringing understanding of iterative techniques to the desired level.

2. FINAL STATEMENT (provided at the date SDEP is completed):

A comprehensive file was assembled on the topic of iterative reconstruction techniques for SPECT imaging. Seventeen reference articles were reviewed. Notes concerning technical aspects of iterative techniques used in SPECT imaging were compiled, with the focus on implementation of OSEM. The file contains examples of clinical images and comparisons with FBP reconstruction suitable for teaching. Contact was made with scientific personnel in two commercial companies (Siemens and General Electric Medical Systems) regarding the effective implementation of OSEM algorithms in their SPECT units.

D. Impact on Practice/Outcome Statement:

1. PROSPECTIVE STATEMENT (provided at the date SDEP is initiated):

Completion of this SDEP will fill gaps in the knowledge base concerning iterative techniques commonly used in SPECT reconstruction. Understanding of the OSEM technique at the fundamental level will enable more effective teaching of residents, instructive communication with nuclear medicine physician colleagues, and assistance in the clinic.

2. FINAL STATEMENT (provided at the date SDEP is completed):

The points made above in D.1 have been accomplished.

a. Personal knowledge has been enhanced regarding the fundamentals of iterative techniques now commonly used in SPECT image reconstruction.

b. The information gathered will be incorporated at the appropriate level in lectures to residents and in communication with professional colleagues.

c. In-depth familiarity with the OSEM technique will allow constructive input to technologists and others in the clinic when questions arise regarding SPECT image quality and improving that image quality.

Example 3: Research

- Title: Revised Estimates of Testicular Dose from Tl-201 Thallous Chloride Procedures
- Category: Research
- Date Initiated:
- Date Completed:
- A. Significance:

Current estimates of testicular dose from Tl-201 thallous chloride procedures are based on restricted data from a limited number of human studies. As utilized by the ICRP, they serve as the primary reference regarding dose to the testes. A new source of data has become available that indicates the actual dose may be two to three times lower than presently quoted. The outcome publication of this SDEP will update the dosimetry reference levels for testicular dose from Tl-201 thallous chloride and constitute a new standard.

- B. Approach:

Revised radiation dosimetry estimates for T1-201 thallous chloride will be developed, utilizing new data specifically acquired to address the issue of testicular uptake of this agent and through reevaluation of extant data for biodistribution in other organs. Quantitative testicular scintigraphy data of sequestered testes (body-background shielded) were obtained from 30 patients (58 studies) injected with T1-201 thallous chloride at peak exercise. Previously published data for 15 patients injected at maximal exercise were reanalyzed to obtain updated biodistribution parameters for designated organs. The biokinetic data will be fit to one or two exponential components using Simulation, Analysis and Modeling (SAAM) software. This output will be used with the Medical Internal Radiation Dose (MIRD) methodology to provide dose estimates. Radiation dose to testes as a function of age will be determined. Comparisons will be made between organ dose estimates derived in this study and those previously published. The dose contributions of possible contaminants (T1-200, T1-202, Pb-203) will be included, with estimates provided for conditions involving injection at the time of the maximum recommended five-day shelf life.

C. Evaluation of Achievement:

1. PROSPECTIVE STATEMENT (provided at the date SDEP is initiated):

Upon completion of the project, a manuscript will be prepared and submitted for publication in a peer-reviewed journal (probably the Journal of Nuclear Medicine). Acceptance in a recognized journal will constitute documentation of the desired level of achievement.

2. SUMMARY STATEMENT (provided at the date SDEP is completed):

The manuscript, entitled "Radiation Absorbed Dose from Thallium-201 Thallus Chloride," was completed and approved by all authors on <date>. The manuscript was submitted to the Journal of Nuclear Medicine <date> and accepted for publication (following review and revision cycles) on <date>.

D. Impact on Practice/Outcome Statement:

1. PROSPECTIVE STATEMENT (provided at the date SDEP is initiated):

Through completion of the research as defined and publication of the associated manuscript, an updated and new dosimetry for Tl-201 thallous chloride will be available for consideration by the nuclear medicine community. This information will enable a more educated approach in decisions related to the conduct and delivery of diagnostic procedures using Tl-201. As such, this work will have significance with regard to practice procedures. In addition, publication will augment my personal curriculum vitae (CV) and enhance visibility of the research contributions of the Department of Radiology.

2. SUMMARY STATEMENT (provided at the date SDEP is completed):

The points made originally in section D.1., above, have been accomplished.

a. New data concerning Tl-201 dosimetry has been made available to the nuclear medicine community with the potential for influencing practice and patient management. (Example: documentation of increased testicular dose as a function of age for consideration prior to Tl-201 use in pediatrics; the significance of contaminants.)

b. The personal aspects of augmenting the first author publication section of my CV and providing visibility for the department's research efforts have been realized.