Editors' Pick

AAPM recommendations on medical physics practices for ocular plaque brachytherapy: Report of task group 221

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What was your motivation for initiating this study?

Eye plaque brachytherapy plays an important role in the treatment of intraocular cancer. With publication of the Task Group Report 129 from the American Association of Physicists in Medicine (AAPM) on eye plaque dosimetry in 2012, the brachytherapy community was informed of the considerable uncertainties and errors in widely-used dose calculations; for example, doses for photon-emitting plaques that follow the AAPM TG-43 report dosimetry formalism may be wrong by as much as 90%. However, TG-129 was primarily focused on plaques in the Collaborative Ocular Melanoma Study (COMS), and did not include general programmatic guidance. Most-importantly, the TG-129 report did not address the widespread use of beta-emitting plaques, which previously lacked professional society guidance. It was important that this work should potentially benefit both newly-developing programmes and established practices, and the inclusion of Drs Kaulich and Vanneste broadened our scope to enable a worldly perspective that would be more beneficial to diverse clinical settings. It was important for us to highlight AAPM, the European SocieTy for Radiotherapy and Oncology (ESTRO), and other guidance (e.g. from the American Society for Radiation Oncology (ASTRO), the American Brachytherapy Society (ABS), and the Netherlands Commission on Radiation Dosimetry (NCS)) when available.

What were the main challenges during the work?

One of the major challenges was to write generalisable recommendations for a wide variety of plaque models that are used with different sources/radionuclides, with variable clinical practice and in different regulatory environments worldwide. There is a lack of commercial and widely available conformité Europeënne (CE)/Food and Drug Administration (FDA) approved advanced model-based dose calculation algorithms for eye plaques with either photon- or beta-emitting sources. Furthermore, for beta-emitting plaques, there is a lack of accessible primary or secondary calibration standards and no commercially-available measurement equipment for clinical metrology. Thus, the development of recommendations that advanced medical physics practice while being realistic, given the current limitations in available tools for clinical physicists, presented considerable challenges.

What is the most important finding of your study?

We have developed a comprehensive set of recommendations in support of medical physics practice for an ocular brachytherapy programme that uses either photon- or beta-emitting sources. This includes guidance for the commissioning of an ocular brachytherapy programme, with general elements that include: recruitment of the clinical team, development of the expected clinical process tree, establishment of processes for treatment planning, definition of a local source calibration standard, assembly and testing of mechanical components, and other, general considerations, such as clinical practice standards for ocular brachytherapy.

What are the implications of this research?

The well-defined set of recommendations that has been developed by our team support standardised medical physics practice towards better eye plaque brachytherapy treatments. We have also made recommendations for future research and development to benefit ocular brachytherapy, especially in cases in which existing clinical infrastructure is lacking. These include a primary or

secondary source standard for beta-emitting plaques and an achievable process for independent source validation. We also recommended the need for advanced dose evaluations, beyond 1D (beta-emitting) and TG-43 (photon-emitting) dosimetry formalisms. Image-based treatment planning and 3D dosimetric evaluations are expected to be possible. Advances in ocular brachytherapy treatment planning, with adoption of advanced TG-186 model-based dose calculation algorithms for eye plaque brachytherapy (photon or beta-emitting), will enable meaningful comparisons between treatments with different plaque types as well as different radiotherapy treatment modalities (e.g. protons or external beam). This may ultimately support revision of the recommended prescription dose, including possible dose de-escalation studies.

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