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Patient safety and the medical physicist

Over the past 18 months several articles have appeared in the "New York Times" and other newspapers describing overexposures of patients to radiation used for medical purposes[1-4]. These articles have revealed problems in the medical use of radiation that must be addressed by medical physicists working with physicians and technologists.

Overexposures in computed tomography

In several institutions, overexposures have occurred during use of x-ray computed tomography (CT) for brain perfusion studies to identify the neurological consequences of strokes and other events. In some cases, patients received exposures that were several times greater than necessary. The overexposures were caused by use of inappropriate CT protocols for brain perfusion studies, and by the desire to achieve appealing low-noise images rather than images acquired at the lowest dose consistent with adequate diagnostic information. Another contributing factor was the cacophony of terms used to describe CT parameters across makes and models of CT scanners.

To resolve these problems, the AAPM hosted a meeting in April, 2010 entitled "CT Dose Summit: Optimization of Protocols". One outcome of the meeting was establishment of a working group with two charges. The first charge was to standardize parameter terminology across different makes and models of CT scanners. The second charge was to develop consensus protocols for CT procedures, beginning with brain perfusion studies, and make these protocols available wherever CT procedures are performed. Consensus protocols for adult brain perfusion studies are now posted on the AAPM website[5], and protocols for other conditions are under development. Discussions are underway with industry about terminology standardization, and guidelines for use of the NEMA XR-25 CT dose-check standard are also posted on the AAPM website[6].

Although recent media attention has targeted computed tomography, other areas of medical imaging also require constant vigilance. In particular, interventional, cardiovascular and neurointerventional imaging procedures use prolonged fluoroscopy together with digital spot acquisitions, resulting often in relatively high radiation dose to patients. As facilities transition to new, more sophisticated imaging equipment, traditional imaging protocols may become obsolete and cause suboptimal images and unnecessary patient exposures if used.

Major campaigns to reduce exposures in medical imaging have been launched by professional organizations, including the AAPM. The Image Gently campaign[7] addresses exposures to pediatric patients, and the Image Wisely campaign[8] focuses on adult patients.

Overexposures in radiation therapy

The "New York Times" also reported patient overexposures caused by mistakes in the calibration and application of therapeutic x ray beams from linear accelerators. Two patients died from overexposures caused by mistakes during radiation delivery, and several other cases have been cited where calibration errors caused patient overexposures.

Stimulated in part by the "New York Times" articles, the AAPM convened a meeting in Miami in June, 2010 entitled "Safety in Radiation Therapy: A Call to Action". The purpose of the meeting was to identify the causes of radiation therapy errors, establish approaches to reducing these errors, and protect patients from disastrous consequences if errors do occur. Twenty recommendations from the meeting were described in an article published simultaneously in the January 2011 issues of "Medical Physics and Practical Radiation Oncology"[9]. Follow-up to the recommendations is currently under discussion within the AAPM, and will in part be the responsibility of the Institute for the Assessment of Medical Devices, a collaboration between the AAPM and the Morgridge Institute of Research based in Madison WI[10].

Some of the recommendations from the Miami meeting can be highlighted. They include (1) reduce distractions and traffic at the accelerator console so that the operator can focus exclusively on patient treatment; (2) simplify the treatment console so that the operator has fewer computer screens to monitor and fewer parameters to track; (3) reduce reliance on

computer-control of the treatment and return control of the treatment to the operator; (4) provide early warning systems to indicate when a treatment exceeds defined parameters, or an equipment malfunction or operator mistake occurs; (5) use checklists and implement a double-check verification process to ensure before treatment that patient and machine set-ups are proper; (6) apply statistical tools to the treatment process to identify potential problems and to analyze the cause of problems when they occur; (7) establish a national reporting system of errors and malfunctions so that everyone can learn from problems at other institutions; (8) encourage external audits and accreditation of treatment facilities to ensure periodic peer-review; (9) reinforce reliance on written policies and procedures to guide the treatment process with individual patients; and (10) empower all members of the treatment team to call "time out" when a treatment design seems inadequate or a treatment process encounters a problem.

Conclusion

Recent reports of overexposures have prompted several initiatives to improve the use of medical radiation so that patient risks are minimized. These initiatives should be led by medical physicists working collaboratively with physicians, technologists, regulators and industrial representatives.

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William R. Hendee
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