Editors' pick

GEC-ESTRO/ACROP recommendations for quality assurance of ultrasound imaging in brachytherapy

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What was your motivation for initiating this study?

The working group of the Groupe Européen de Curiethérapie-European SocieTy for Radiotherapy and Oncology (GEC-ESTRO) that is engaged in quality assurance (QA) issues for brachytherapy (BT) (the brachytherapy physics quality assurance system group, or BRAPHYQS) noticed that there was a lack of comprehensive, modern QA procedures for application of ultrasound (US) imaging in BT. The American Association of Physicists in Medicine (AAPM) published a good report on the use of US in prostate BT in 2008. Since the publication of this TG-128 report, the use of US has evolved as electronic probes have become standard. We felt the need to consider not only the QA of the US system, but also the interplay of the US system, the stepping device and the treatment planning system (TPS). This is quite important, since techniques that use real-time BT to treat prostate cancer involve direct linkage of the US system to the TPS and the stepper. Also, some users of the technique had requested clear guidance regarding the QA of US in BT. Some members of the BRAPHYQS group had also found difficulties during application of BT procedures that could have been avoided if they had been able to access a well-designed QA for US. Some had even started to design their own clinical QA programmes for application of US in BT. Thus, we decided to develop European-wide guidelines for QA in US imaging that was used in BT.

What were the main challenges that you faced during the work?

There are several different US systems that employ a variety of interfaces to the TPS in BT. We found it a challenge to cover all combinations and to elaborate a good strategy for quality checks that involved minimal effort for the user. The manuscript that we have produced is divided into several sections, which cover physical aspects of US, presentation of US phantoms, image quality of US units, QA of the TPS, and QA for BT of prostate, anal and gynaecological cancers. At the end of the report, an example sheet for QA in use of US to treat the prostate is provided.

To explain all QA tests at length would have exceeded the extent of a scientific manuscript. Therefore, we decided to submit a short summary for publication in the *Green Journal* and a longer, more detailed version in electronic form only. Nevertheless, the short version includes all the important facts to ensure QA in US BT.

For the application of US in BT, only a few suitable QA phantoms are on the market. In the recommendations, we have tried to propose quality checks that are independent of the dedicated phantom model and describe as far as possible checks that can be conducted through use of a simple water tank. Through this choice of easy solution, we present some hints to improve these applications. For example, the water temperature is important in cases in which geometrical measurements are conducted in a water tank. Degassed water improves the signal-to-noise ratio, and the phantom should not be too small in order to avoid multiple echoes.

What are the most important findings of your study?

The recommendations compile a consensus of modern state-of-the-art techniques that should be adapted to a larger audience. It is notable that for our guidelines, we have summarised and structured important quality-control tests for use of US in BT. In particular, we have produced on the one hand the tests that are necessary, such as the scaling of images and image quality checks,

and on the other hand, procedures that may be required to check more complex issues such as offset calibration of biplane probes, QA for stepper movements including their link to the TPS, and needle reconstruction in US images.

What are the implications of this research?

The guidelines condense important quality controls that should be performed for the application of US in BT and summarise these in a single table that includes test frequencies, phantom materials that are needed, and tolerances. The time commitment that is necessary to implement the guidelines is very low in comparison with QA programmes for linear accelerators or afterloaders, but the benefit is high because wrong calibrations in US BT systems can result in systematic errors that affect the treatments of many patients. A medical physicist will have to spend just a few hours per year to meet the guidelines in the clinic, as most tests are recommended to be carried out annually. Finally, we hope that the inclusion of these new GEC-ESTRO recommendations in the list of established GEC-ESTRO recommendations will improve the quality of US imaging in BT throughout Europe and thus improve BT treatment for patients.

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